

Fatigue Risk Management

Solutions

Facilitating practical, effective FRMS implementations and positive cultural change

enquire@interdynamics.com www.interdynamics.com

Contents

Our Risk-Based Approach to Managing Fatigue	3
An Effective FRMS	5
Managing Fatigue Survey	7
Managing Fatigue Training Workshop	9
Fatigue Hazard Analysis Risk Assessment Workshops	12
HAZAID	16
GRAID Organisational Fatigue Risk-Grading	20
GRAID IT	21
The FAID Quantum Suite of Products	23
About InterDynamics	31

FAID[®], GRAID[™] and HAZAID[™] are either trademarks or registered trademarks of InterDynamics Pty Ltd.

Except where otherwise stated, the contents of this document are the Intellectual Property and Copyright of InterDynamics Pty Ltd. Until such time as permission may be granted under an agreement with InterDynamics, permission is not granted for the use, reproduction, or distribution of this document for commercial purposes

Our Risk-Based Approach to Managing Fatigue

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

Tel: +61 7 3229 8300 enquire@interdynamics.com Many organisations faced with the challenge of managing fatigue can easily become daunted by the prospect. Impairment associated with fatigue can be difficult to detect, and harder still, is judging the level of impairment that could present a danger. Added to the complexity of individual differences in experiencing fatigue is the context for individuals (e.g. job type, activities, environment, time of day, etc.) and the degree to which this is vulnerable to fatigue.

Given the diverse factors needing to be taken into account in managing workrelated fatigue, a risk-based approach that gives consideration to models like James Reason's 'Swiss Cheese' model is often recommended.



The Defences-in-Depth model (Dawson & McCulloch, Sleep Med. Rev. 2005) applies James Reason's model to the fatigue context, targeting prevention through a series of barriers, safeguards, and defences. InterDynamics has included these concepts and ideas in its <u>Risk-Based Approach</u> to managing fatigue, summarised in the following diagram.





InterDynamics' approach recognises the development of an appropriately informed plan to manage fatigue (a Fatigue Management Plan) as foundational to the effective implementation and on-going improvement of a Fatigue Risk Management System (FRMS). Staff engagement and consultation is key to a smooth FRMS implementation, as cultural change is often required for the organisation to transition its perception and management of fatigue in line with the organisation's fatigue policy commitment.

Our experience assisting clients of all sizes across various industries and circumstances has brought insights into the most effective organisational team structures and project plans for successful implementation.

The aim of the Risk-Based Approach is to provide our clients with the best possible tools and resources to manage fatigue risks. It is founded on four pillars: consultation, staff engagement, shared responsibility and effective risk management.

This comprehensive methodology includes three key steps:

- 1. Determining the fatigue risk profile of the organisation
- 2. Protecting against unacceptable fatigue-related risks
- 3. Reviewing systems to ensure protection measures remain adequate

Suggested FRMS Scope and Implementation activities are outlined in the second and third columns of the diagram, respectively. The last column presents supporting InterDynamics services and products that facilitate the FRMS journey. Deliverables and findings from each implementation activity give additional insight into the organisation's specific requirements for managing fatigue effectively, as well as providing valuable input into the Fatigue Management Plan and supporting Work Procedures.

InterDynamics' Risk-Based Approach to managing fatigue targets improved safety and performance as key outcomes of the FRMS.

InterDynamics and Zurich Risk Engineering have developed an organisational fatigue risk grading system (GRAID[™]) to provide senior and operational managers with a systematic methodology to ascertain the quality of their organisational risks associated with fatigue. In conducting FRMS reviews, InterDynamics can provide a valuable third-party perspective on the depth, breadth and relevance of your Fatigue Risk Management System.





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 shift work 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 other FRMS support offerings

Tel: +61 7 3229 8300 enquire@interdynamics.com An effective Fatigue Risk Management System (**FRMS**) is one that is able to avoid an intolerable event by detecting a fatigue-related error prior to it translating into an incident or accident.



A model FRMS can be summarised into 4 key areas of influence as part of addressing fatigue-related risks:

1. Promoting and fostering a safety culture that recognises fatigue as a safety concern.

Organisations and individuals that recognise fatigue as a safety concern are more likely to respond appropriately as fatigue-related risks escalate. A culture of concern can be stimulated by adequate fatigue education and training that focuses on managing fatigue-related risks for the organisation as well as the individual.

Adequate staff engagement and consultation is required to truly foster a cohesive and effective FRMS. Sufficient protections and treatments can only be developed through an approach which draws on the experience and feedback of personnel.



Comprehensive FRMS support:

- InterDynamics' <u>Managing</u>
 <u>Fatigue Survey</u> provides a
 practical mechanism for staff
 engagement and consultation,
 as well as ongoing improvement
 of organisational fatigue
 management. A gauge of
 changes in company culture with
 respect to fatigue management
 can also be achieved through
 multiple uses of the
 questionnaire over time.
- InterDynamics' <u>Managing</u>
 Fatigue Training Workshop
 has been successfully utilised
 across the aviation, construction,
 energy, rail and marine
 industries, equipping participants
 with general awareness
 information on managing fatigue,
 managing the social and lifestyle
 impacts of working shift work, as
 well as providing personally
 relevant and practical techniques
 for managing individual fatigue.
- InterDynamics' FRMS
 <u>Management Workshop</u>
 provides the perfect starting
 point for practical discussion and
 engagement with the
 management team on the issues
 of fatigue and fatigue
 management. Coupled with
 results from a Managing Fatigue
 Survey and a current state
 analysis, the organisation's
 Fatigue Risk Profile can be
 reviewed, with action plans
 developed by the management
 team at this workshop.
- InterDynamics can customise
 FAID Quantum to suit an
 organisation's specific
 requirements, or carry out <u>FAID
 Quantum Hours of Work
 Diagnostics on behalf of an
 organisation.
 </u>

InterDynamics can work cooperatively with an organisation to develop an <u>investigative tool</u> to determine the likelihood of fatigue as a contributing factor to an incident / accident.

2. Implementing protective measures to avoid unacceptable fatiguetriggered events.

A risk assessment that takes into account hazards in the context of fatigue is required to ensure adequate protective measures are in place. The objective is to not only minimise the likelihood of fatigue but also to safe-guard personnel when fatigue is present. InterDynamics' <u>Fatigue Hazard Analysis Risk</u> <u>Assessment Workshop</u> facilitates this form of risk assessment by assessing the likelihood and consequence of fatigue-triggered events, and determining associated risk improvement actions for a particular job type / role.

3. Ensuring the fatigue exposure of working hours are not at an unacceptable level.

Compliance to hours of work rules may not be sufficient to ensure safety with regards to fatigue. Many regulators and industry bodies recognise that within an FRMS, adequate management of fatigue-related risks associated with working hours includes more than working hour limits. Circadian influencers and biological limits to recovery are also important. Consideration of these factors can most effectively and efficiently be supported by the strategic use of a biomathematical model such as <u>FAID® Quantum</u>.

FAID Quantum takes into account the time of day and duration of work / break periods, the accumulating effect of fatigue, and the biological limits on recovery sleep. All these factors are difficult to include in hours of work rules without these rules being very complex and prescriptive, thereby restricting viable business operations. FAID Quantum is a business decision support tool that can be used to limit hours of work-related fatigue exposure, while still providing operational flexibility.

FAID Quantum can be used to:

- Understand an organisation's current hours of work fatigue exposure level;
- Review changes in hours of work fatigue exposure trends over time;
- Plan rosters within agreed fatigue exposure levels;
- Allocate overtime, shift swaps, any roster changes, etc. to within agreed fatigue exposure levels; and
- Audit actual hours of work to ensure compliance within agreed fatigue exposure levels, and consider business process improvements for non-compliant hours.
- 4. Proactively investigating fatigue as a possible contributing factor to incidents and accidents.

Understanding when fatigue has been a contributing factor to an incident or accident is imperative to minimising a reoccurrence related to fatigue, and ensuring the effectiveness of an organisation's FRMS. This investigative process allows an organisation to identify any gaps in its FRMS and develop appropriate corrective actions.



Managing Fatigue Survey

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

Tel: +61 7 3229 8300 enquire@interdynamics.com InterDynamics provides the opportunity to survey your employees via an anonymous questionnaire aimed at gathering data on individual experience of fatigue and fatigue management within your organisation. Surveying staff is one of a number of fundamental elements within <u>InterDynamics'</u> <u>Risk-based Approach</u> to managing fatigue.



The questionnaire provides personnel the opportunity to provide feedback on individual fatigue management, as well as thoughts on the effectiveness of the organisation's current strategies. Participants are asked questions on personal coping strategies, and their understanding and/or engagement with their organisation's current Fatigue Risk Management System (**FRMS**), associated policies and procedures. The questionnaire also seeks to ascertain a view of participants' current sleeping conditions, possible work and non-work related inhibitors to achieving quality sleep and various exposures to help build a profile of their current risk with relation to fatigue.



The standard questionnaire takes an individual approximately 10 minutes to complete and can be provided to personnel in three modes:

- Emailed web link A link to the on-line questionnaire is emailed to individuals, who then complete the questionnaire by selecting the link and filling in their responses. Personnel must have internet access to utilise this method of delivery.
- Emailed PDF form A PDF
 version of the questionnaire is
 emailed to individuals, who then
 complete the questionnaire by
 answering the series of
 questions provided within the
 PDF document. Personnel must
 have installed Adobe Acrobat
 Reader version 10 (or greater).
 The PDF form is then
 confidentially emailed back to
 InterDynamics for collation.
- Paper-based form A hardcopy of the questionnaire is provided to individuals, who complete the questionnaire by answering the series of questions provided within the 1 page, double-sided form. This requires copies of completed forms to be collected by or posted to InterDynamics for data collation and analysis.

Feedback from the questionnaire is provided as grouped or summarised data in a report back to the organisation. InterDynamics' staff survey provides a practical mechanism for staff engagement and consultation, as well as ongoing improvement of organisational fatigue management. Feedback from the survey can be taken into account in developing action plans for improving fatigue management, through targeted communication and education, and contributing to the enhancement of operational practices. A gauge of company culture with respect to fatigue management can also be achieved through multiple implementations of the Managing Fatigue Questionnaire over time. In the instance only a single implementation of the staff survey is conducted a current view of fatigue or a climate survey with respect to fatigue is achieved.



Managing Fatigue Training Workshop

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

Tel: +61 7 3229 8300 enquire@interdynamics.com Targeted communication and education on fatigue is key to stimulating positive organisational culture, and effective change management related to the risks presented by workers who are fatigued. InterDynamics' Managing Fatigue workshop is the perfect starting point for practical staff engagement and positive change on the issues of fatigue and fatigue management.

Focused on providing insight into the short and long-term issues associated with personal fatigue, strategies for managing fatigue both at work and at home, and getting the most out of a healthy work-life balance, this two hour workshop yields useful discussion and practical information that has been valued by participants as the impetus for behavioural change leading to increased safety and a better experience of life.

InterDynamics' <u>Managing Fatigue Training Workshop</u> has been successfully implemented across the aviation, construction, energy, rail and marine industries, providing participants with general awareness information on managing fatigue, managing the social and lifestyle impacts of working shift work, as well as dietary and other techniques for managing personal fatigue.



InterDynamics Navigating complexity. Delivering clarity. InterDynamics' Managing Fatigue Training Workshops also provide participants the opportunity to share individual strategies for managing fatigue, and discuss their effectiveness. Consideration is given to topics such as working hours, body clock, social rhythms, family impacts, health, sleep disorders, commuting, Ideal sleeping conditions, napping, food, water, caffeine, alcohol intake and fatigue risk management concepts.

The Fatigue Management Training Workshop approach is based on the following key objectives:

- · Providing practical information and skills to manage fatigue
- · Learning how to recognise fatigue
- Reducing the impact of fatigue
- Increased safety
- Increased communication around fatigue
- Balancing work and the rest of life

Some of the feedback from participants on our Managing Fatigue Training Workshops:

Strengths of the Workshop

Increased awareness / understanding

It gave me a better understanding of why I react the way I do after a long day at work - *Flight Operations* I am better equipped to deal with fatigue - able to recognise when I am fatigued and things to do to avoid it and manage my stress - *Cabin Services*

Presentation / instructor

The instructor was very clear with her message, and used great tools to help us understand - *Flight Operations* Very well presented: concise and relevant - *Flight Operations*

Use of tools / data / written materials

The workshop was highly informative and professionally presented, with the handout book an absolute plus - *Cabin Crew* Clear communication. Videos used and quite funny too! - *Cabin Services*

Relevance

As pilots, fatigue is becoming part of life. From this workshop we know how to manage it properly - *Pilot* Very relevant to work and its environment and also to our families - *Cabin Services*

Attitude Change

It will enable me to be more honest about any effects of fatigue and my work - *Flight Operations* Implementing this training will assist me to be less moody, and be more aware of how to handle and manage fatigue - *Cabin Services*



How will the knowledge and skills gained assist you in your position/function?

Improved work performance

It will help my functional performance and my ability to be prepared, especially during a night shift where my alertness levels are very low - *Flight Attendant*

It will help us manage fatigue and be more productive at work - *Engineering*

Preventing incidents / improving safety

My goal is to be more proactive in managing fatigue for a safer flight deck environment - *Flight Operations* Has created great awareness, and will help us to put controls in place - *Flight Operations*

Improved relationships

This training has encouraged me to try and improve my sleeping habits, food selection, water intake, and relationships - *Flight Operations*

This will help me to improve my effectiveness at work and at home. My relationships will be improved by better communication - Cabin Services

Understanding the importance of sleep

It will assist me in improving the quality of my sleep and therefore improve my work productivity - Cabin Services

It will help me to cope with fatigue, especially my dietary intake and understanding of how sleep and rest are very important - Cabin Services

Better organisation / time management / improved work-life balance

It will assist me in managing my time and balancing work, family and home - *Engineering* I'm going to try to get more sleep and be more work, family and socially oriented, attaining a better balance in life. Will also improve my health standards by doing more exercise and eating healthier foods - *Flight Operations*

Improved health and nutrition

This helps a lot with the type of food and drink I can consume to help during night shifts - *Engineering* This training will help me to prepare myself well before a duty in terms of good rest, physical exercise and eating healthy -*Cabin Services*

Sharing of knowledge / better teamwork

I will now provide awareness to others at work, home, church and especially family!!! - *Flight Operations* I'm going to try for better time management and eating habits, and to communicate more and encourage each other -*Cabin Services*

Proactive engagement in managing fatigue

Now I will acknowledge more when fatigue is an issue in my life and in my performance. It has educated me to manage it more proactively - *Traffic*

Going to take full responsibility for my part in minimising fatigue for myself e.g. my diet, exercise and getting enough sleep - Cabin Crew



Fatigue Hazard Analysis Risk Assessment Workshops

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 other FRMS support offerings

Tel: +61 7 3229 8300 enquire@interdynamics.com An InterDynamics Fatigue Hazard Analysis (FHA) Risk Assessment establishes a bridge between an organisational Fatigue Risk Management Policy and the operational procedures, activities and risk treatments required to effectively manage fatigue. This interactive process supports the development of appropriate treatments/controls and protection for tasks exposed to, or vulnerable to fatigue.

An approved methodology

<u>Fatigue Hazard Analysis (FHA) Risk Assessments</u> can play a significant role in an organisation's journey towards a comprehensive Fatigue Risk Management System. It is at the heart of our Risk-Based Approach to fatigue management. Fatigue Hazard Analysis risk assessments are designed to establish a bridge between Fatigue Risk Management at an organisational level, and the procedures, activities and treatments required at an operational level.

- Draws on the knowledge of experienced staff to capture fatigue related incidents that could or have occurred during the performance of daily duties, their possible triggers and solutions.
- Identifies and plots the Likelihood and Consequence of fatigue related incidents whilst performing the tasks of a particular role.
- Determines a Task Risk Tolerance for comparison with other workgroups or to be set as the organisational risk tolerance level.
- Assists in the capture and analysis of data required to set meaningful FAID Quantum Fatigue Tolerance Levels for selected jobs or tasks.
- Enables prioritisation of treatments by identifying most at risk tasks and individuals.
- Records agreed treatments and procedures for implementation.

The strength of this process is its proven effectiveness, being grounded in the hazard analysis and risk assessment methodology developed and practiced by one of the world's leading insurers. Zurich's Hazard Analysis (**ZHA**) methodology (upon which InterDynamics' Fatigue Hazard Analysis is based) has been successfully applied across various industry sectors for over 20 years.



InterDynamics' Fatigue Hazard Analysis methodology has been successfully practiced across numerous industry types including road transport, rail, marine, aviation, health, and emergency services.

"The Fatigue Hazard Analysis was an invaluable process which brought together the experience of our experts from the field to learn about the causation and effects of fatigue, determine the triggers and consequences within our operating environment, and workshop the priority 'fixes' for some of these issues."

Fiona Love - Director, Training and Development Sydney Ferries

At the core of InterDynamics' Fatigue Hazard Analysis (FHA) is the Zurich Risk Engineering methodology of Zurich Hazard Analysis (ZHA) similar to frameworks such as:

- AS/NZS ISO 31000:2009 (formerly AS/NZS 4360)
- CAN/CSA-Q850-1997
 BS 6079-3:2000



AS/NZS 31000:2009 Risk Management Process

Benefits of a Fatigue Hazard Analysis Risk Assessment

- The Fatigue Risk Management component of the Safety Management System is based on data from objective analysis & organisational experience
- Results in Fatigue Risk Management controls that are transparent, agreed and understood at all levels, and sit above regulatory compliancebased systems
- Provides benchmark data for fatigue-related exposures and controls
- Provides specific reports that document acceptable levels of fatigue related risk exposure levels for operating tasks
- Demonstrates ongoing commitment to reducing fatiguerelated risk
- A cost-effective way to establish consistent, business-wide, fatiguerelated risk assessment & documentation processes
- Prioritises risk reduction investments
- Establishes a proactive process for periodic fatigue risk management reviews

- Security of knowing that treatments are built on real knowledge & experience of fatigue-related exposures of the actual work
- Employee participation in identifying improvement actions that will lead to the reduction of overall fatigue-related risk
- Provides an opportunity to contribute to identifying acceptable fatigue related risk exposure levels for jobs/tasks
- Knowledge and communication is improved through information about fatigue-related risk & scientific facts of sleep deprivation being available to all
- Treatments/controls are transparent, agreed & specific to each team/group/department
- Provides assurance of the organisational commitment to regularly reviewing fatigue-related risk and processes to enable it
- Employees have input as to what is done first
- Acceptable & unacceptable fatigue-related risks are identified and made clear to all



FAID[®], GRAID[™] & **HAZAID™** are proprietary products developed by InterDynamics to aid in the consistent identification, analysis and treatment of fatigue related risk. These tools are emerging as a de facto standard for fatigue management in numerous industries across Asia-Pacific, **Europe and the** Americas.

InterDynamics' FHA Toolkit

The FHA risk assessment process is based on the Zurich Hazard Analysis (ZHA) methodology and uses:

- 1. FAID Quantum diagnostic software that analyses hours of work and provides a scientifically based fatigue exposure assessment of work patterns
- 2. <u>HAZAID</u> an interactive, visual tool that standardises the FHA process. HAZAID prompts participants to catalogue hazards and assess fatigue-risk associated with their roles and working environment
- 3. <u>GRAID FRMS</u> an interactive fatigue-related risk grading tool that supports results from the hours of work analysis and risk assessment process. GRAID FRMS produces a priority order for implementing the controls designed to manage fatiguerelated risk appropriately.

What happens in a Fatigue Hazard Analysis risk assessment workshop?

All participants are encouraged to contribute equally and, in the process, HAZAID and GRAID FRMS software are used to record the information gathered from the group. From these records a report to management is prepared.

It is important that all participants are able to confidently contribute to these sessions and share their practical experience of fatigue-related risks as they relate to the task/job. For these reasons, a workshop usually includes suitable overviews of fatigue and fatigue-related risk. A typical format would include:

- Introduction to fatigue and fatigue-related risk
- Current fatigue and sleep research knowledge
- Discussion of FAID Quantum reports from the Hours of Work Analysis
- The Fatigue Hazard Analysis Process using HAZAID
- Organisational Fatigue-related Risk Grading using GRAID FRMS

What is entailed in running a FHA risk assessment workshop?

Each tailored workshop can take from a day and a half to two days, and is focused on a single functional task/group (i.e. airline pilots, truck drivers, train engineers, marine pilots, nurses, etc.)

For best results, 3-5 consulting days are usually required to complete the process comprising the following elements:

Prior to the workshop

- Completion of a FAID Quantum analysis of planned and actual Hours of Work, ideally covering a 12 month period
- Collate & analyse staff survey results from InterDynamics' Managing Fatigue Survey
- In consultation with staff and management, qualified Fatigue Risk Management consultants can: review company records for possible fatigue-related occurrences, absenteeism and sick leave performance; and/or gather specific information on the safety metrics for the organisation and its industry, e.g. Lost Time Injury Frequency (LTIFR) reports, insurance claims

The workshop

- Selection, in consultation with management, of a suitable group of people (nominally 8-10) for the workshop(s)
- Delivery of tailored workshop(s) facilitated by the InterDynamics team leader, and collection of information from participants
- Preparation of detailed report of workshop, including FAID Quantum data and participant's responses
- Presentation and discussion of report with selected management and/or staff.

N.B. To avoid operational disruptions it is recommended that workshops be held away from the workplace.



In the interest of good practice, InterDynamics draws attention to these opinions from our scientific and other advisors:

- Fatigue is defined as, a physiological state of reduced mental or physical performance capability resulting from sleep loss or extended wakefulness, circadian phase, or workload (mental and/or physical activity) that can impair a person's ability to perform their duties efficiently and safely
- In extended, 24-hour operations a well-designed roster is unlikely to provide adequate protection from fatigue
- Integrated risk-based systems are designed to incorporate the collection of multiple data streams related to: predicted, actual, acute, &/or cumulative fatigue; fatigue surrogate variables, e.g. workload, overtime; and metrics for assessing human capability, e.g. cockpit flight-data monitoring, production
- Information from FAID Quantum can assist in evidencing a Fatigue Tolerance Level for an operation
- Information from FAID Quantum may be used in forming the basis of a continuous monitoring program to support risk detection and evidence-based change

Understanding your Organisation's tolerance to fatigue within a Risk Management context:





HAZAID

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

Tel: +61 7 3229 8300 enquire@interdynamics.com HAZAID[™] Hazard Cataloguing and Risk Assessment Tool is used to record the Fatigue Hazard Analysis (FHA) risk assessment information gathered during a FHA workshop. It is highly visual and interactive, and is used to ensure a high standard is maintained for information captured during the workshop process.

Fatigue Hazard Scenarios are defined by:

- Tasks (WHAT / WHERE?) e.g. operation of equipment.
- Triggers (HOW / WHY?) which include
 - Errors caused by one or more fatigue impairments (e.g. communication, situation assessment / mental models / memory / performance insight and
 - any other type of trigger (e.g. weather, equipment defects, lack of fuel, schedule recovery)
- Effects (HOW BAD HOW BIG, HOW OFTEN?)

Risk assessment (severity/probability) of each scenario is then determined by:

- Reports of accident and incidents that are part of the organisations' safety management system;
- Details and statistics of accidents and incidents that are available from Safety Authorities (such as a Civil Aviation Safety Authority) who have responsibility for industry wide safety; and
- Details and statistics of accidents and incidents for the organisations' industry that are available from the organisations' insurer.

Existing Controls are noted and the effect on the organisation as a result of a scenario is then determined and noted, e.g.

- Increased scrutiny by safety authorities and insurers;
- Down-time due to equipment malfunction caused by user error; or
- Poor market image.

During the workshop, a Task Risk Profile matrix is drawn and then once additional controls are determined and the scenarios are rerated to achieve a Task Risk Improvement Profile matrix (see Figures 1 - 4).





Figure 1 - Identifying the Hazards



Figure 2 - Risk Profile – Task Risk





Figure 3 - Risk Profile - Fatigue Risk



Figure 4 - Risk Profile comparing current to future improvements



Outcomes of a Fatigue Hazard Analysis (FHA) using HAZAID

Outcomes of a FHA include

- Setting of appropriate benchmark figures for FAID Score and KSS Tolerance Levels, and Target Compliance percentages, for specific tasks or roles
- Increased employee engagement and contribution in the identification of acceptable fatigue related risk exposure levels, and other necessary controls that can inform the development and continuous improvement of the Fatigue Management Plan; leading to the reduction of overall fatigue-related risk, and greater acceptance and effectiveness of risk improvement actions (including the use of FAID Quantum)
- Treatments/controls that are transparent, agreed & specific to each team/group/department
- Acceptable & unacceptable fatigue-related risks identified and made clear to all
- Security of knowing that the Fatigue Risk Management component of the Safety Management System is being based on data from objective analysis & organisational experience
- Documented records of outcomes and the level of rigour applied to determining tolerable levels of fatigue related risk exposure and recommended treatments
- Prioritisation for risk reduction investments
- Benchmark data for future review of fatigue-related exposures and controls
- Fatigue Risk Management controls that are transparent, agreed and understood at all levels, and sit above regulatory compliance-based systems
- Increased employee confidence in the ongoing commitment by the organisation to reducing fatigue-related risk through regular reviews and best practice processes
- Improved knowledge and communication through information about fatigue-related risk & scientific facts of sleep deprivation being available to all
- Consistent, repeatable, fatigue-related risk assessment & documentation processes



GRAID FRMS: Organisational Fatigue Risk-Grading

GRAID FRMS[™] is an organisational fatigue risk-grading tool, used to <u>rate the adequacy of current and future safeguards</u>, making up an organisation's Fatigue Risk Management System (FRMS). Twenty-four fatigue grading elements or risk factors, assigned varying levels of importance, are reviewed. At the end of the review an overall grading is determined, providing feedback on the level of protection of the organisation's FRMS against fatigue-related risks. This systematic assessment tool gives participants the opportunity to express their views on fatigue-related exposures and risks that are grounded both in objective data as well as participants' experience.

InterDynamics and Zurich Risk Engineering have developed the organisational fatigue risk grading system to provide senior and operational managers of organisations a systematic methodology to ascertain the quality of their organisational risks associated with fatigue. Information from the grading process can be used to enhance the development and implementation of the organisation's fatigue risk management initiatives.



Applied as a benchmarking tool, GRAID FRMS can be used at a later stage to compare current and past results to document any achievements and changes in the organisations FRMS.

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

Tel: +61 7 3229 8300 enquire@interdynamics.com



GRAID Investigation Tool

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

Tel: +61 7 3229 8300 enquire@interdynamics.com InterDynamics' GRAID[™] Investigation Tool can be used to rate the likelihood of fatigue contributing to an occurrence. This systematic and situation specific assessment tool offers organisations a consistent and practical approach to reviewing occurrences or fatigue reports as part of their Fatigue Risk Management System (FRMS). A key outcome of the Tool is a GRAID Scorecard, and an indication from Low to Very High of the likelihood Very High

indication from Low to Very High of the likelihood Very High that fatigue was a significant contributor to the occurrence.

InterDynamics has developed the GRAID Investigation Tool to support organisations in the ongoing improvement of their FRMS. In an occurrence investigation, GRAID facilitates a systematic

approach, and the ability to identify the relative contribution of fatigue-related elements. Organisations can use the GRAID Scorecard results to target high priority areas for improvement or further detailed review.

Likelihood That Fatigue Contributed to Occurrence: Very High								
Level	Element	Туре	Element Name	Influence Factor	Completed			
Stage 2	PR4	Preliminary	Non-compliance to work/rest rules	М	С			
Stage 2	PR5	Preliminary	Samn-Perelli fatigue checklist	VH	D			
Stage 2	PR6	Preliminary	Self observed symptoms/behaviours	М	В			
Stage 2	PR7	Preliminary	Personal health/medication	М	С			
Stage 2	PR8	Preliminary	Third party observations of symptoms/behaviours	М	D			
Stage 3	EP1	Extended	Use of rest days	M	В			
Stage 3	EP2	Extended	Secondary employment	Н	С			
Stage 3	EP3	Extended	Jetlag/significant time zone changes (within past week)	M	D			
Stage 3	EP4	Extended	Prior sleep in previous 48 hours	VH	В			
Stage 3	EP5	Extended	Fatigue-related training	L	С			
Stage 3	EP6	Extended	Sleep disturbance due to alcohol	L	D			
Stage 3	EP7	Extended	Commute times prior to occurrence	M	A			
Stage 3	EP8	Extended	Sleep inertia	M	В			
Stage 3	EP9	Extended	FAID combined hours of work assessment	Н	A			
Stage 3	EP10	Extended	Fatigue detection technology	M	В			
Stage 3	EC11	Extended	Alerting strategies	M	A			
Stage 3	EC12	Extended	Quality of employer provided sleeping environment	M	B			
Stage 3	EC13	Extended	Predictability of working hours	L	С			
Stage 3	EC14	Extended	Medical screening and monitoring	M	D			
Stage 3	EC15	Extended	Record of absenteeism/sick days	M	A			
Stage 3	EC16	Extended	Expectations and incentives which may increase personal	Н	A			
Stage 3	EC17	Extended	Fatigue risk management policies and procedures	L	A			
Stage 3	EC18	Extended	Fatigue hazard analysis	M	A			
Stage 3	EC19	Extended	Rostering practices take into account fatigue	H	В			
Stage 3	EC20	Extended	Response/control measures	M	С			

GRAID applies a risk grading system developed by Zurich Risk Engineering. Information from the grading process can be used to enhance the development and implementation of the organisation's fatigue risk management initiatives.



Low

GRAID IT provides users the opportunity to review 20 fatigue-related elements to test the likelihood of fatigue as a contributing factor. The elements are grouped into 3 review stages:

- 1. Stage 1: Details
- 2. Stage 2: Preliminary
- 3. Stage 3: Extended

Stage 1: Details, prompts the user to document any facts, data, and/or comments associated with the occurrence or fatigue report being investigated, under the 'Information Details' field of each element. A user can choose 3 options when completing a Stage 1 element:

- 1. SUBMIT when submitting documented 'Information Details'.
- 2. Don't know? no information is available to document.
- 3. NA when the element is not applicable to the investigation.

Stage 2: Preliminary, takes the user through eight initial questions pertaining to the specific individual(s) involved and circumstances surrounding the occurrence. The grading of these questions determines whether there is a strong indication that there was a Low likelihood that fatigue was a significant contributing factor in the occurrence. If so, the grading may be concluded at that point. If however the likelihood was not determined to be Low, any of the preliminary questions were answered 'N/A', 'Don't Know', or not answered, then the user is required to continue through the complete grading to receive a GRAID outcome and likelihood rating.

Stage 3: Extended provides a higher resolution of investigation, with consideration to both personal and corporate/systemic fatigue-related contributors.

Users have 5 options under each of Stage 2 and 3 elements, incorporating the grading scale (right):



Low Risk or Extensive Control Medium Risk or Comprehensive Control High Risk or Limited Control Very High Risk or Severely Lacking Control Don't Know Not Applicable

Once selected, grading scales for each element are summarised in the GRAID Scorecard and can be reviewed at any time by selecting: Scorecard



Related References

- 1. Edwards, D., Sirois, W. G., Dawson, T. A., Davis, W., Trutschel, U., Aguirre, A., Sommer, D., Operator Fatigue, Detection Technology Review (2008), Caterpillar, Peoria, IL.
- 2. Gutierrez, J.L.G., Jimenez, B.M., Hernandez, E.G., & Lopez, A.L., (2004-5), Swedish Occupational Fatigue Inventory (SOFI): Factorial replication, reliability and validity. *International Journal of Industrial Ergonomics 35 (2005)* 737:746.
- Hallowell, M. R., (2010), Worker Safety Worker Fatigue, Managing concerns in rapid renewal highway construction projects. *Professional Safety*, *December 2010*, 18:26.
- 4. Hart, S.G., (2006), NASA-Task Load Index (NASA-TLX); 20 Years Later, NASA-Ames Research Center, Moffett Field, CA.
- Hoonakker, P., Carayon, P., Gurses, A.P., Brown, R., Khunlertkit, A., McGuire, K., & Walker, J.M. (2011), Measuring workload of ICU nurses with a questionnaire survey: the NASA Task Load Index (TLX), IIE Transactions on Healthcare Systems Engineering (2011) 1, 131:143.
- Hystad, S. W., Saus, E.R., Saetrevik, B., Eid, J., (2013) Fatigue in seafarers working in the offshore oil and gas resupply industry: effects of safety climate, psychosocial work environment and shift arrangement, *Int Marit Health* 2013; 64, 2:72-79



FAD® Quantum Fatigue Assessment Tool

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

Tel: +61 7 3229 8300 enquire@interdynamics.com 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, <u>FAID Quantum</u> 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 <u>BMM Warning</u> 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.



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:

- Time of day of work and breaks
 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 <u>Our</u> <u>Risk-Based Approach</u> 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 riskbased 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

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





Data can be easily copied to and from spreadsheets



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 <u>training in the context</u> and functionality of FAID <u>Quantum</u> 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 <u>Fatigue Hazard Analysis Risk Assessment</u> 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).



InterDynamics' Risk-Based Approach includes <u>Hours</u> of Work Diagnostic <u>Reports</u>.

By providing 12 months of actual and planned Hours of Work data, analysis and recommendations can be made on your historical and planned position in relation to Hours of Work fatigue exposure.

When complete, a FAID Quantum diagnostic can usefully complement one or more Fatigue Risk Management Solution Educational Workshops.

The same data may also provide the basis for starting a <u>Fatigue</u> <u>Hazard Analysis Risk</u> <u>Assessment Workshop</u>, utilising a Zurich Risk Engineering validated approach.

Customisations for reading client data sources, crew augmentation to meet client rules and sleep quality adjustments are available.



Other Variants and Customisations

The <u>FAID Quantum Roster Tool</u> 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 <u>Shared Object Library</u> 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:

Customers are attracted to Interdynamics' Fatigue Risk Management Solutions because they are supported by leading insurers, operational practitioners, and human factors scientists.

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 hours1, or
 - b. the time zone difference is three hours or less, and the rest period between the duties is less than 48 hours².
- 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.

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



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.

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.

FAID Standard BMM References

- Caruso, C., Hitchcock, E., Dick, R., Russo, J., & Schmit, J., (2004). A report on Overtime and Extended Work Shifts: Recent Findings on Illnesses, Injuries, and Health Behaviours. Prepared for U. S. Department of Health and Human Services, Centers for Disease Control and Prevention and National Institute for Occupational Safety and Health.
- 2. Dawson, D., & Reid, K. (1997). Fatigue, alcohol and performance impairment. *Nature, July 1997*, 388:235.
- Dawson, D., & Fletcher, A. (2001). A quantitative model of work-related fatigue: Background and definition. *Ergonomics*, 44(2), 144-163.
- Dean, D.A., Fletcher, A., Hursh, S. R., & Klerman, E. B. (2007). Developing Mathematical Models of Neurobehavioral Performance for the "Real World", *Journal of Biological Rhythms*, 22, 246-258.
- 5. Dorrian, J., Hussey, F., & Dawson, D. (2007). Train driving efficiency and safety: examining the cost of fatigue, *Sleep Research*, *16*, 1-11.
- Dorrian, J., Roach, G. D., Fletcher, A., & Dawson, D. (2007). Simulated train driving: Fatigue, self-awareness and cognitive disengagement, *Applied Ergonomics*, 38, 155-166.
- Fletcher, A. (1999). Measurement and management of work-related fatigue: Development and preliminary validations of a predictive model. Ph.D. Thesis, 1999, The University of South Australia.
- 8. Fletcher, A. (2010). Staying Safe in the Jungles of Borneo: Five Studies of Fatigue and Cultural Issues in Remote Mining Projects. *Industrial Health, 48,* 406-415.
- Fletcher, A., & Dawson, D. (1997). A predictive model of work-related fatigue based on hours of work. *Journal of Occupational Health and Safety – Australia and New Zealand*, 13(5), 471-485.
- Fletcher, A., & Dawson, D. (1998). A work-related fatigue model based on hours-of-work. In L. Hartley (Ed.) *Managing Fatigue in Transportation*, Oxford, Pergamon Press, 189-208.
- Fletcher, A., & Dawson, D. (2001). Evaluation of a fatigue model using data from published napping studies. *Journal of Human Ergology*, 30, 279-285.
- 12. Fletcher, A., & Dawson, D. (2001a). A quantitative model of workrelated fatigue: empirical evaluations. *Ergonomics*, *44(5)*, 475-488.
- 13. Fletcher, A. & Dawson, D. (2001b). Field-based validations of a workrelated fatigue model based on hours of work. *Transportation Research*, *Part F4*, 75-88.
- Fletcher, A., Lamond, N., van den Heuvel, C., & Dawson, D. (2003). Prediction of performance during sleep deprivation and alcohol intoxication by a quantitative model of work-related fatigue. *Sleep Research Online*, *5*(2), 67-75.
- Fletcher, A., Roach, G.D., Lamond, N. & Dawson, D. (2000). Laboratory based validations of a work-related fatigue model based on hours of work. In: S. Hornberger, P. Knauth, G. Costa, S. Folkard (Eds.) *Shiftwork in the 21st Century: Challenges for Research and Practice*. Peter Lang, Frankfurt am Main, Germany.
- Lamond, N., Dorrian, J., Burgess, H. J., Holmes, A. L., Roach, G. D., McCulloch, K., & Dawson, D. (2004). Adaptation of performance during a week of simulated night work. *Ergonomics*, 47(2), 154-165.
- Lamond, N., Dorrian, J., Roach, G. D., McCulloch, K., Holmes, A. L., Burgess, H. J., & Dawson, D. (2003). The impact of a week of simulated night work on sleep, circadian phase, and performance. *Occupational & Environmental Medicine*, *60(11):* e13. doi:10.1136/oem.60.11.e13
- Paradowskie, M., & Fletcher, A. (2004). Using task analysis to improve usability of fatigue modelling software, *International Journal of Human-Computer Studies*, 60(1), 101-115.



- Roach, G. D., Burgess, H. J., Lamond, N., Dorrian, J., Holmes, A. L., Fletcher, A., & Dawson, D. (2001). A week of simulated night work delays salivary melatonin onset, *Journal of Human Human Ergology*, 30 (1-2), 255-260.
- Roach, G. D., Dorrian, J., Fletcher, A., & Dawson, D. (2001). Comparing the effects of fatigue and alcohol consumption on locomotive engineers' performance in a rail simulator, *Journal of Human Human Ergology*, *30 (1-2)*, 125-130.
- Roach, G. D., Fletcher, A., & Dawson, D. (2004). A model to predict work-related fatigue based on hours of work. *Aviation, Space and Environmental Medicine*, 75(3, Section II), A61- A69.
- 22. Roach, G. D., Lamond, N., Dorrian, J., Burgess, H. J., Holmes, A. L., Fletcher, A., & Dawson, D. (2005). Changes in the concentration of urinary 6-sulphatoxymelatonin during a week of simulated night work, *Industrial Health, 43*, 193-196.

FAID Quantum BMM References

23. Darwent, D.J, Dawson, D. & Roach, G. (2012). A model of shiftworker sleep/wake behaviour, *Accident Analysis & Prevention, vol. 45, supplement*, pp. 6-10.

FAID Standard & FAID Quantum BMM References

- 24. Åkerstedt T, Folkard S (1995) Validation of the S and C components of the three-process model of alertness regulation. *Sleep* 18: 1–6
- 25. Dawson, D., Riedy, S.M & Vila, B. (2019), US Police Rosters: Fatigue and public complaints. *Sleep, Volume 42, Issue 3.*
- Riedy, S., Dawson, D., Fekedulegn, D., Andrew, M., Vila, B., and Violanti, J.M. (2020), Fatigue and short-term unplanned absences among police officers, *Policing: An International Journal*, doi:10.1108/PIJPSM-10-2019-0165
- Riedy, S., Fekedulegn, D., Andrew, M., Vila, B., Dawson, D. & Violanti, J. (2020). Generalizability of a biomathematical model of fatigue's sleep predictions, *Chronobiology International.* doi:10.1080/07420528.2020.1746798
- Riedy, S., Roach, G., & Dawson, D. (2020). Sleep-wake behaviors exhibited by shift workers in normal operations and predicted by a biomathematical model of fatigue, *Sleep, zsaa049*. doi:10.1093/sleep/zsaa049

Time Zone Specific

- 29. Auger, R. R., & Morganthaler, T.I. (2009) Jet lag and other sleep disorders relevant to the traveler, *Travel Medicine and Infectious Diseases*, *7*(*2*), 60-68.
- Battelle Memorial Institute, JIL Information Systems. (1998). An overview of the scientific literature concerning fatigue, sleep, and the circadian cycle. Prepared for the Office of the Chief Scientific and Technical Advisor for Human Factors, Federal Aviation Administration, Washington, DC.
- Eastman, C. I., Gazda, C. J., Burgess, H. J., Crowley, S. J., & Fogg, L. F. (2005), Advancing circadian rhythms before eastward flight: a strategy to prevent or reduce jet lag, *Sleep, 28(1),* 33-44.
- 32. Klein, K. E., & Wegmann, H. M. (1980). The effect of transmeridian and transequatorial air travel on psychological well being and performance. In L.E. Scheving, & F. Halberg (Eds.), *Chronobiology: Principles and Applications to Shifts in Schedules* (pp. 339-352). Rockville, MD: Sijthoff & Noordhoff.
- 33. Waterhouse J., Reilly, T., Atkinson, G., & Edwards, B. (2007). Jet lag: trends and coping strategies, *The Lancet, 369*, 1117-1129.
- Waterhouse, J., Edwards, B., Nevill, A., Atkinson, G., Reilly, T., Davies, P., & Godfrey, R. (2000). Do subjective symptoms predict our perception of jet lag?, *Ergonomics*, 43, 1514-1527.



About InterDynamics

InterDynamics was created in 1992 with a founding mission to visualise the way organisations work in a way never before possible, applying human intelligence, interactive software and the highest professional values.

We now work with some of the world's leading names in transportation, logistics, mining and manufacturing, providing decision support solutions and fatigue risk management methodologies.

While our business was born in Adelaide, Australia, we have expanded to include a nationwide and overseas network of consultants and developers to meet the needs of a growing client base.

Shedding new light on business operations

In order to provide a big picture view of the way organisations operate, we use Planimate, our own simulation based application development platform, first created in 1989. Since then, Planimate has continuously delivered a variety of management tools, supporting planning and scheduling and improving operational profitability.

In 1999, we released FAID (now FAID Quantum). This ground-breaking software uses scientific studies of fatigue and impairment to help individuals and organisations exposed to shift work-related fatigue. FAID is based on a fatigue-scoring formula licensed from the University of South Australia's Centre for Sleep Research. FAID Quantum now also incorporates a second biomathematical model developed through research by the Appleton Institute using real world sleep-wake data to provide highly accurate alertness prediction.

Building on FAID's philosophy, a broader approach to Fatigue Risk Management was developed by InterDynamics, in conjunction with Zurich Risk Engineering. Our Risk-Based Approach takes an integrated view of fatigue risks, equipping businesses to manage these risks more effectively.

Our clients

At InterDynamics, we are fortunate to have worked with many large, multinational organisations. We are particularly proud of our role in developing and implementing the Delivery Vehicle Scheduling System for the Sydney Olympics.

In March 2010, InterDynamics delivered, on time and on budget, the Truck Arrival Scheduling System used by the Port Authority of New York and New Jersey for the World Trade Centre (NYC) construction.



Some of our clients include:

- Aurizon
- Australian Reef Pilots
- Babcock MCS
- BNSF
- Coles Myer
- easyJet Airline
- Endeavour Energy
- EDI Rail
- Federal Aviation Administration
- Fiji Airways
- Fleet Management
- Fortescue Metal Group

- Hitachi Europe
- JSW Steel
- One Rail
- Pacific National
- Plains All American Pipelines
- Public Transport Authority of WA
- Qantas
- Roy Hill
- Sydney Trains
- TasPorts
- Union Pacific Railroad
- Yarra Trams

InterDynamics services an international market for Planning, Scheduling and Rostering Solutions and is considered a leading international supplier of:

- Fatigue Risk Management system design and implementation
- Work schedule analysis and manpower planning software tools
- Change management support solutions that are focused on reducing the risks associated with fatigue in the workplace

Our Risk-Based Approach follows international risk management standards (AS/NZS ISO 31000:2009) in the identification of and protection against fatigue related risks. Through consultation, staff engagement, shared responsibility and effective risk management, this multi-layered solution helps inform an organisations Fatigue Management Plan and operational risk controls.

Contact Details

Head Office:	Christie Centre. 320 Adelaide Street, Brisbane, QLD 4000				
	Phone:	+61 7 3229 8300			
	Fax:	+61 7 3112 4145			
ACN:	057 037 (057 037 635			
ABN:	21 057 037 635				
Web Page:	www.inte	rdynamics.com			

Email: <u>enquire@interdynamics.com</u>

