TP 14575E
April 2007

Fatigue Risk Management System
for the Canadian Aviation Industry

Developing and Implementing a Fatigue Risk Management System

Transport Canada Transports Canada

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Notices

Une traduction de ce document est également disponible en français : «*Système de gestion des risques liés à la fatigue pour le milieu aéronautique canadien : Élaboration et mise en oeuvre d'un système de gestion des risques liés à la fatigue*», TP 14575F.

Preface

This document is part of the Fatigue Risk Management System (FRMS) Toolbox for Canadian Aviation developed by Transport Canada and fatigue consultants *edu.au* of Adeliade, Australia.

The FRMS toolbox includes the following components:

1 *FRMS for the Canadian Aviation Industry: An Introduction to Managing Fatigue*, TP 14572E: introductory material intended to raise awareness about fatigue

2. *FRMS for the Canadian Aviation Industry: Fatigue Management Strategies for Employees*, TP 14573E: provides the knowledge and skills required to apply appropriate fatigue management strategies at the individual level

3. *FRMS for the Canadian Aviation Industry: Employee Training Assessment*, TP 14574E: an optional module intended to assess employee competence in topics covered in the Fatigue Management Strategies for Employees workbook

4. *FRMS for the Canadian Aviation Industry: Developing and Implementing a Fatigue Risk Management System*, TP 14575E: explains how to manage the risks associated with fatigue at the organizational level within a safety management system framework

5. *FRMS for the Canadian Aviation Industry: Policies and Procedures Development Guidelines*, TP 14576E: proposes a policy structure while providing examples and guidelines to help organizations through the process of designing fatigue risk management policies and procedures

6. *FRMS for the Canadian Aviation Industry: Fatigue Audit Tools*, TP 14577E: provides an overview of tools available to employers to help determine whether scheduling provides employees with adequate opportunities to get sufficient sleep.

7. *FRMS for the Canadian Aviation Industry: Trainer's Handbook*, TP 14578E: in addition to a training presentation on fatigue, fatigue management systems, and individual fatigue management strategies, the package includes background information for delivery of the workshop, learning outcomes, and questions frequently asked by participants

These documents are available on the Transport Canada web site at *www.tc.gc.ca*

Contents

Introduction

The Aim of This Guide

This guide is designed for individuals who are responsible for managing fatigue risk at an operational level. You should already have completed the *Fatigue Management Strategies for Employees* (TP 14573E) workbook or equivalent, which provided information about the causes and consequences of fatigue, and included practical strategies for managing the impact of fatigue. *Fatigue Management Strategies for Employees* focussed on reducing fatigue risk at the individual level. You should now be familiar with the risks associated with fatigue and the major contributors to increased fatigue levels (i.e., inadequate quality and/or quantity of sleep, time of day, and length of time awake). This guide explains how the risks associated with fatigue can be managed at the organizational level within a safety management system framework. You will learn how to implement fatigue risk management controls systematically within your organization.

Your Role

As an individual in a managerial or supervisory role you are accountable not only for managing your own fatigue levels but also the fatigue risk of employees within your organization and/or work unit. The tools and strategies presented in this guide have been developed to help you manage fatigue risk at various levels, ranging from ensuring compliance with legal and regulatory requirements to investigating and learning from accidents and incidents in the workplace. Managing fatigue-related risk in the organization is achieved using a fatigue risk management system (FRMS).

How to Use This Guide

This guide describes how an FRMS is best employed within an organization's safety management system. This allows the risks associated with fatigue to be managed in a way similar to other hazards such as dangerous goods. An FRMS should be based on an internal risk assessment of the organization. This ensures that any fatigue management strategies being implemented are measured, appropriate,

and targeted. There are several Canadian national standards for risk assessment, all of which clearly outline acceptable guidelines for risk management (e.g., CAN/CSA-Q850-97[1], CAN/CSA-Q634-91[2]).

The fatigue risk management system described in this guide provides your company and employees with a recognized process based on likelihood and consequence and the need to identify, understand, and control the workplace hazard. The resources and time required for implementing a fatigue risk management system will be determined by the relative risk identified during your risk assessment process.

There are six major aspects to an FRMS:

1. Policies and Procedures
   - Outline the commitment of organizational management to manage fatigue-related risk
   - Detail the required procedures for managing fatigue at the operational level

2. Responsibilities
   - List personnel responsible for FRMS design, implementation, and maintenance
   - Document responsibilities of individual employees and work groups

3. Risk Assessment/Management
   - Scheduled versus actual hours of work
   - Individual sleep patterns
   - Symptom checklists
   - Error/incident reporting

4. Training
   - Promote knowledge in the workplace about risks, causes, and consequences of fatigue
   - Ensure employees understand and can apply fatigue management strategies

5. Controls and Action Plans
   - Toolbox of methods used within the FRMS, including error reduction techniques ("fatigue proofing")
   - Clear decision trees for managers and employees to use when fatigue has been identified as a risk

6. Audit and Review
   - Documentation and data collection at regular intervals of how the FRMS works
   - Review of the FRMS based on audit results

[1] Canadian Standards Association (1991). *CAN/CSA-Q634-91 Risk Analysis Requirements and Guidelines, Quality Management – A National Standard of Canada.* Rexdale (Toronto).

[2] Canadian Standards Association (1997). *CAN/CSA-Q850-97 Risk Management: Guideline for Decision-Makers*. Rexdale (Toronto).

CHAPTER 1

Overview of Fatigue Risk Management

Learning Outcomes

On completing this chapter, you will be able to:

- Explain reasons underlying the need for organizations to implement fatigue risk management systems.
- Explain the limitations of prescriptive hours of work for managing fatigue-related risk.
- Name the major components of a fatigue risk management system (FRMS).

CHAPTER 1

Overview of Fatigue Risk Management

In recent years, organizations have become better at managing workplace risks including issues such as materials handling, use of seatbelts and safety harnesses, as well as exposure to harmful chemicals. As these risks have been reduced, other threats have become more apparent. This is particularly true of fatigue, which until recently was not well understood or easy to measure. Recent research and applied management strategies are beginning to provide solutions for individual employees and organizations to better manage fatigue-related risk. This chapter of the guide provides information about managing fatigue-related risk within a safety management system (SMS) framework. This incorporates a formal risk assessment and will likely fit within existing organizational safety management structures. The rationale for the development of a fatigue risk management system is also provided in this chapter.

Causes and Consequences of Fatigue

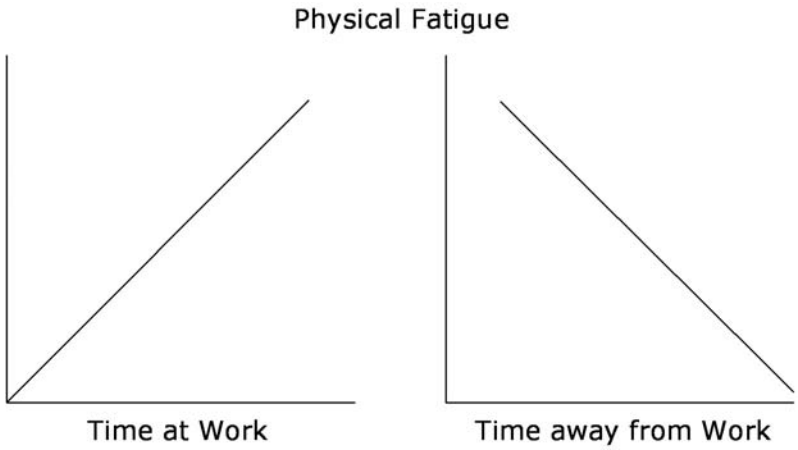
Fatigue is an experience of physical and/or mental tiredness that results in reduced alertness and negatively impacts performance. The major cause of fatigue is not having obtained adequate rest or recovery from previous activities. In simple terms, fatigue largely results from inadequate quantity or quality of sleep. As discussed in *Fatigue Management Strategies for Employees*, there are many consequences of fatigue and they fall into three major categories – physical (e.g., abruptly nodding off for a few seconds, called a microsleep), mental (e.g., lapses in attention) and emotional (e.g., irritability).

The fatigue associated with tiredness and reduced alertness is different from physical fatigue or weariness that is caused by long and/or hard physical work. In this case, fatigue may be more accurately defined as mental fatigue although it certainly affects physical performance as well – especially tasks that require mental-physical interactions like hand-eye coordination, reaction time, and fine motor skills. Other skills that are impaired by fatigue include attention, vigilance, concentration, ability to communicate information clearly and accurately, and decision-making. Impairment can lead to fatigue-related errors, which in turn can lead to incidents or accidents. Evidence

from industrial and government investigations as well as industrial risk data demonstrates that fatigue and sleepiness are major contributors to incidents and accidents across the entire transportation industry. Incidents and accidents that result from fatigue can be severe and may include fatalities but are most often associated with employee injury and/or equipment damage.

Managing Fatigue Levels

An understanding of both the causes and consequences of fatigue enables us to design more effective systems to manage fatigue-related risk. Fatigue is sometimes managed indirectly by organizations (and regulators) through prescriptive limits on work hours, often because it is seen as the only available option. There is an assumption that prescribing maximum limits for the length of work shifts and minimum thresholds for breaks between shifts ensures that employees achieve adequate rest and recovery. This assumption most likely evolved from information about the way in which humans recover from physical fatigue. Physical fatigue accumulates and diminishes in a predictable way over time, as shown in the figure below.



The manner in which physical fatigue accumulates and dissipates in relation to work and rest

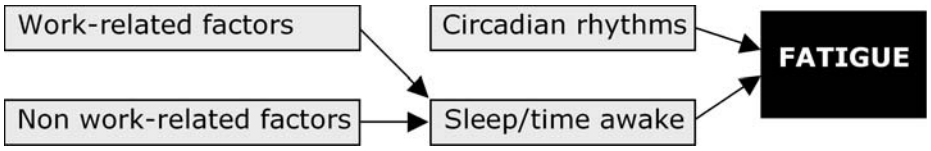
Based on this assumption, the management of physical fatigue by limiting work hours and managing break periods is logical and practical. However, the same may not be assumed for mental fatigue. Common approaches for managing this type of fatigue often assume that the factors that cause mental fatigue are similar to those that cause physical fatigue. And while it is true that mental fatigue does, in part, increase in a relatively predictable way over time during waking hours and dissipate over a period of recovery, time is not the only factor that needs to be considered. The most important factors affecting mental fatigue levels are:

- Sleep quantity and quality – insufficient or poor quality sleep results in increased fatigue levels. This is because both how much and how well one sleeps are important for recovery from fatigue and for maintaining normal alertness and performance. This applies not only to a single sleep period, but to consecutive sleep periods. If an individual gets inadequate sleep (quality or quantity) over a series of nights, this also causes increased fatigue.
- Time awake – how long an individual is awake affects fatigue levels. Research indicates that alertness and performance levels begin to decrease after a certain number of hours awake.
- Circadian rhythms – fatigue levels are also affected by the time of day. For example, fatigue can be a bigger problem in the early hours of the morning due to biological (or circadian) rhythms. Sleepiness levels are naturally higher and alertness levels are lower at 3 a.m. than at 3 p.m. Circadian rhythms also influence sleep quality and quantity. For instance, sleep obtained during the day is poorer in quality compared to night sleep, when the body is programmed to sleep.

It is not correct to assume that a given break from work will provide a given level of recovery; the length of the break is not the key factor. It is the amount and quality of sleep obtained in the period of time away from work that determines recovery from fatigue. The timing of a work period within the 24-hour day will also determine fatigue risk.

Both work and non-work factors can affect sleep. Work-related factors – length of shifts, the type of work being performed, workload, work environment (e.g., heat, humidity, noise, vibration, lighting levels) and breaks within a shift – can all influence the amount of sleep and time awake obtained in a 24-hour period.

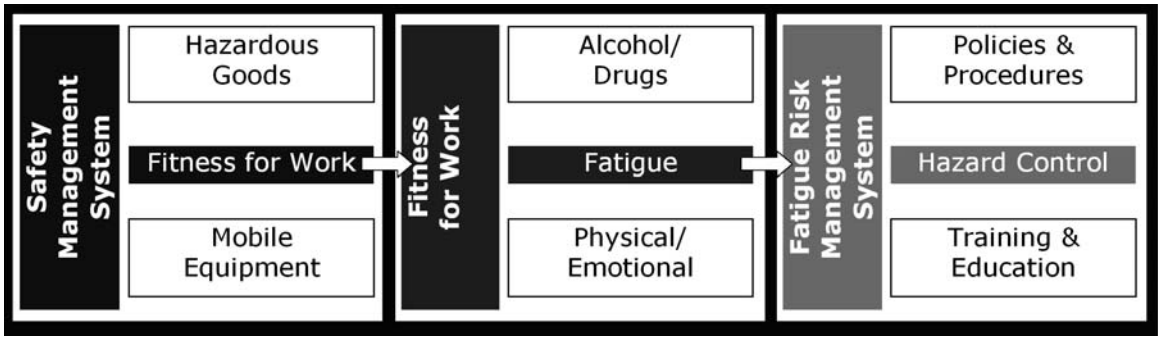
Non work-related factors – sleep disorders, family responsibilities, social and leisure engagements, and emotional stress – can all affect the amount and quality of sleep people obtain. These factors can also affect the length of time individuals are awake, which can also affect fatigue. The figure below shows the relationship between each of these factors.



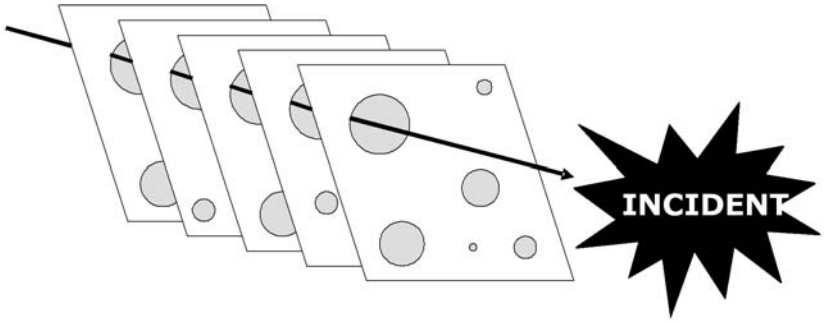
The relationship between sleep, time awake, circadian rhythms, and fatigue, as well as the effect of work and non-work factors on sleep and time awake.

With all of the contributing factors in mind, it is easy to understand why prescriptive limits on work hours may not, on their own, be adequate for managing fatigue-related risk. Prescriptive limitations on shift length generally assume that a break of a given length has a predictable recovery value; for example, that a 10-hour break will allow the same recovery to take place regardless of when the break occurs. While this may be relatively true for physical fatigue, it is definitely not the case for mental fatigue. Providing the same time off during the day, as opposed to night, may result in less recovery due to the effect on sleep. Factors such as this must be taken into account when developing an FRMS.

The FRMS should be embedded within the existing SMS framework to allow fatigue to be managed within existing organizational safety structures. This also ensures that responsibility for managing fatigue risk is shared between employer and employee. It may also allow safety professionals or other stakeholders in the company to develop a cost-effective FRMS without needing to call in outside fatigue expertise. However, it is important to have an understanding and appreciation of fatigue-related risk within a workplace.The figure below illustrates how fatigue can be incorporated into an overarching SMS.



Fatigue risk management systems work best within the framework of a larger safety management system.



An incident trajectory demonstrates how weaknesses or "holes" in management systems can provide opportunity for incidents

A Risk-Based Approach

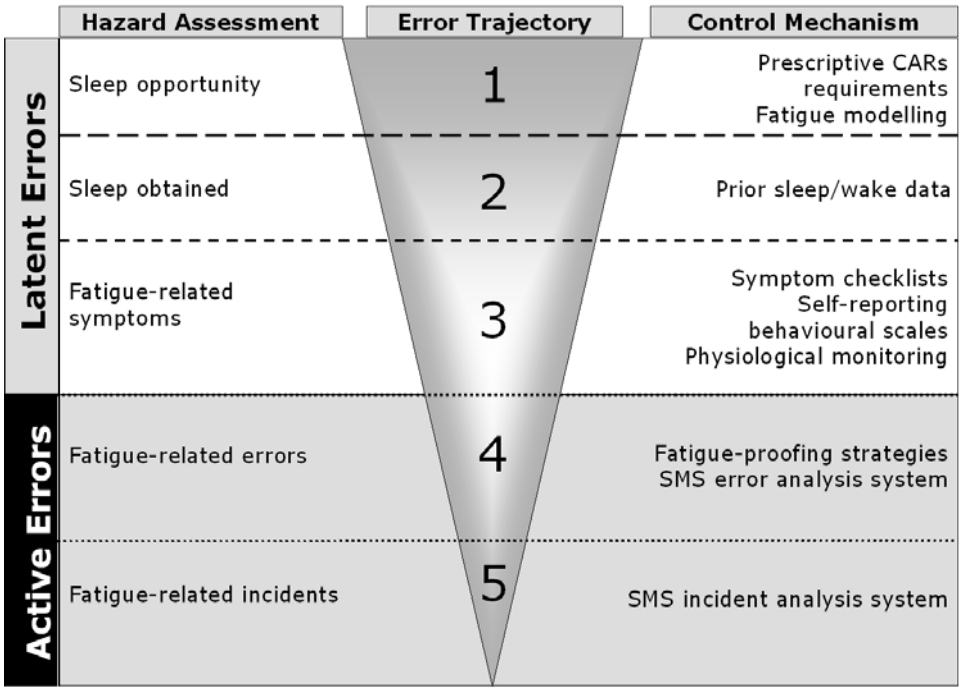
Managing fatigue-related risk under an SMS framework involves developing comprehensive defences against the hazard of fatigue based on a formal assessment of risk. Organizations can decide to do as much or as little as necessary to manage their own levels of risk.

An important theorist in the area of organizational risk management, James Reason, describes the "normal" environment in organizations that generally precedes a workplace incident. Reason suggests that there is no 100% effective safety control for any hazard (such as fatigue). The inherent weaknesses or "holes" in a given safety defence provide opportunities for incident "trajectories" – the series of events and conditions leading to an incident – to penetrate the defence.

An effective safety management system or, in this case, fatigue risk management system, should use multiple, overlapping, and redundant defences against a given hazard. In a multi-layered system, an incident can only occur when all the defensive systems fail. That is, in circumstances where the incident trajectory passes through the holes in each of the defensive layers. The effectiveness of the safety management system can therefore be improved by (1) the appropriate selection of supplementary layers, and/or (2) strengthening individual layers (shrinking the holes).

Reason's principles for the development of an SMS can be easily applied to a fatigue risk management system. The figure below shows a hazard control diagram for fatigue. Vulnerabilities along the fatigue-related incident trajectory should be identified so that supplementary defensive layers can be introduced and/or existing defensive layers can be strengthened. Investigating incidents also ensures that appropriate hazard controls are put in place at each level of potential risk.

In general, fatigue has traditionally been managed using a single layer of defence (i.e., limits on work hours). The assumption is that compliance with the limits on working hours is evidence that an employee is adequately rested and fit for work and will not make any fatigue-related errors. This may not always be the case. Without supplementary defensive layers it is entirely possible for an employee to comply with working hour limits but to be too tired to work safely (e.g., had a 12-hour break from work but didn't get enough sleep due to a sick child or a night out on the town). Each of the five levels of control is discussed in separate chapters, but a brief description of the theory is provided below.



Hazard-Control Model for Fatigue Risk Management

The hazard control model illustrated in the figure above shows the controls in place for reducing fatigue-related risk. In theory, if each level of control is in place, the "holes" in the management system along the incident trajectory should become smaller, minimizing the likelihood of a fatigue-related incident.

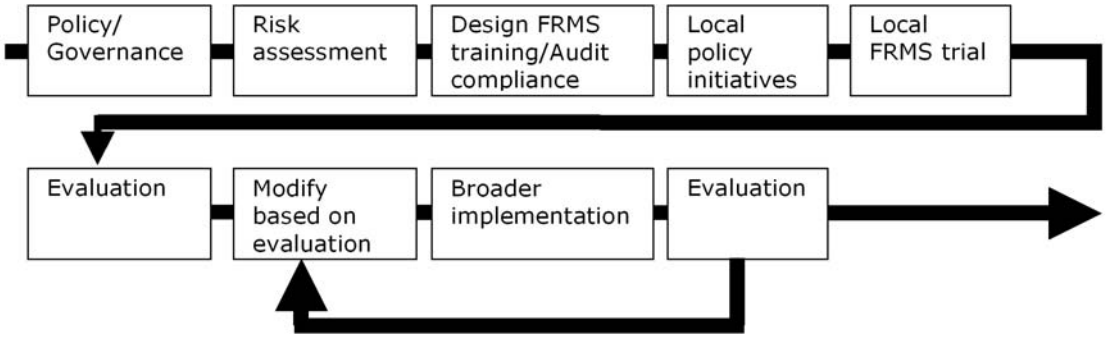
Briefly, a fatigue-related incident is preceded by a fatigue-related error. In turn, a fatigue-related error is generally preceded by fatigue-related behaviours. Fatigue-related behaviours or symptoms in turn indicate that an employee has either not had adequate sleep (not enough or not enough good sleep), or has been awake for an excessive period of time. Finally, inadequate sleep or excessive time awake may occur as a result of inadequate sleep opportunity (i.e., too short a break between work shifts).

There are five major levels of control for managing fatigue risk:

- Level 1 (organizational): making sure scheduling gives employees adequate opportunity to sleep
- Level 2 (individual): making sure employees actually get sufficient sleep
- Level 3 (behavioural): monitoring for symptoms that indicate employees are fatigued
- Level 4 (error): stategies to ensure that fatigue in the workplace does not result in errors or incidents
- Level 5 incident: determining the role of fatigue in workplace errors or incidents

A successful fatigue risk management system addresses each of these levels by organizing defence systems around these layers. Most fatigue countermeasures (either formal or informal) can be assigned to one of the five defensive layers.

The FRMS should be developed and implemented using a risk-based approach. Organizations should determine the specific level of fatigue-related risk associated with their operations. Organizational risk should be assessed in terms of the type of work being conducted as well as the environment in which the work takes place. After identifying high-risk areas for fatigue within the workplace (by work group or by specific tasks), systems can be put in place to either reduce or eliminate fatigue through processes such as schedule reform (fatigue reduction) or through the implementation of mitigating strategies such as napping and task rotation (fatigue proofing).



Implementation Map

The figure above provides a plan, or roadmap, for organizations implementing an FRMS. The individual components of an FRMS are designed to complement each other to ensure the best possible outcomes for fatigue risk management and safety. This guide details each of the components recommended for an effective FRMS, and provides information on the relevant implementation process. No single component should be considered more important than another – all components should be examined and integrated into the FRMS to achieve the ultimate goal of safety.

An FRMS Working Group

The design, implementation, and day-to-day operation of any management system require structure and leadership. A working group should be formed to assume responsibility for the FRMS in the organization. In smaller operations, the role of a working group may be performed by one or two employees – the size and makeup of the group will be dictated by the level of fatigue-related risk the organization carries and the size of the organization itself. It is also possible that an existing safety-oriented committee could take on the role of the FRMS working group.

The working group is responsible for the design, implementation, and ongoing review of the FRMS. The working group should be composed of a representative sample of employees likely to be affected by the FRMS. Ideally, it also includes management and operational personnel. This increases the range of opinions and ensures that information is received from all levels of the organization. Working group members should also have the opportunity to consult with other operational personnel, bringing an even wider range of perspectives to the process of FRMS design, implementation, and review. This is best achieved through two-way communication of program objectives, milestones, progress, and the involvement of all employees in the development and review processes.

Working Group Training

Members of the working group may require some training about the causes and consequences of fatigue and how to manage the risks. Training for the working group should:

- outline fatigue, its associated risks, and management strategies at the individual level
- provide strategic information on the daily management of fatigue from an organizational perspective
- detail effective FRMS design and implementation processes
- provide information about how to evaluate and audit the FRMS over time.

This type of training can be obtained from *Fatigue Management Strategies for Employees* (TP 14573E) and this guide. Further reading on these issues can be found in the list of resources included at the end of this guide.

CHAPTER 2

Responsibility for Managing Fatigue under an FRMS

Learning Outcomes

On completing this chapter, you will be able to:

- Define specific responsibilities for both employers and employees for fatigue risk management.

CHAPTER 2

Responsibility for Managing Fatigue under an FRMS

One of the key features of risk-based approaches to safety management is that all stakeholders share responsibility for minimizing risk and increasing safety. This approach works particularly well for managing fatigue. Management has a responsibility to create a work environment that minimizes fatigue-related risk, and employees have an obligation to ensure that time away from work is used appropriately. Spreading responsibility for fatigue risk management across the entire organization represents a significant shift in thinking.

In the past, responsibility for safety has generally been mandated by the regulator, who prescribed the level of safety management required and audited the organization to determine compliance. If safety was found to be poorly managed and resulted in an accident or incident, the organization could be held legally liable and face fines or a jail sentence. Thus, if an employee fell asleep at work and caused an accident, the organization could potentially be held responsible.

As our understanding of the hazards of fatigue has increased, we have begun to recognize the many different contributors to the risk. It is now accepted that the regulator, the organization, and employees each have certain responsibilities for fatigue risk management. The main responsibilities are summarized in the table below.

In the context of an FRMS, both employers and employees have responsibilities for the management of fatigue. The employees' responsibility is first, to obtain sufficient sleep; second, to report when they have been unable to do so or feel at risk of making a fatigue-related error; and finally, to report any situation observed that may present fatigue-related risk. The employer has the responsibility of providing adequate sleep opportunity, mitigating fatigue-related risk, and taking action if an employee is not fit for work. Managers and supervisors are responsible for taking prompt, consistent, and appropriate action whenever they believe an employee is not fit for duty. The action(s) to be taken should be set out clearly and consistently in all documentation, including policies and procedures. The aim of all actions should be to maintain and promote safety.

Responsibilities for Fatigue Risk Management

Government/ Regulatory Responsibilities	Organizational Responsibilities	Individual Responsibilities
• Prescribe requirements/ framework for FRMS • Assess compliance • Audit non-compliance • Where appropriate, investigate accidents/incidents	• Provide support: - Compliance with legislation - Policy development - Training and education - Error/incident reporting systems • Ensure work schedules provide adequate opportunity for rest and recovery between shifts • Assess specific work tasks for fatigue-related risk	• Use time away from work appropriately to obtain adequate rest and recovery, and ensure fitness for work • Report any potential risks to manager if experiencing fatigue-related symptoms • Report any situation that may present fatigue-related risk

Actions to be considered when an employee is considered potentially unfit for work may include:

1. Assessing the employee using a symptom checklist as a guide to physical, mental, and emotional signs of fatigue (see Chapter 7).
2. Providing closer regular supervision of the employee by peers, work team, or supervisor.
3. Giving the employee lower-risk tasks.
4. Providing the employee with an opportunity to rest/nap and to be reassessed within a determined time frame.
5. Discussing with the employee what the employee thinks were factors in being unable to maintain fitness for work.
6. Determining whether prescription medication, alcohol, or drugs may be involved or have contributed to the situation.
7. Determining whether a similar set of circumstances is likely to recur, and if so, how could it be satisfactorily addressed by either the employee and/or manager for a mutually acceptable outcome.
8. Providing alternative transport home, if warranted.
9. Assisting the employee to access support and assistance where available (e.g., employee assistance programs).

Employee assistance programs (EAPs) are confidential services funded by companies and provided to any employee who may require assistance for personal, work, and/or family-related concerns or problems. In some organizations, the service is extended to immediate family members (i.e., current spouse and children). Referrals can be made by an employee, supervisor, manager, or medical officer. Service providers can be internal or external to the organization with services varying in scope, range, and intensity.

EXERCISE

- Detail who is responsible for each FRMS component within your organization.

CHAPTER 3

Policies and Procedures

Learning Outcomes

On completing this chapter, you will be able to:

- Describe the importance of developing an FRMS policies and procedures manual.
- Write a mission statement, outlining the scope, objectives and purpose of the FRMS and design subsections of an operationally specific policies and procedures manual.

CHAPTER 3

Policies and Procedures

As discussed in Chapter 1, it is the responsibility of company management, or a fatigue risk management working group, to produce a policies and procedures manual. This includes ensuring that employees are consulted and have the opportunity to provide feedback throughout the policy development process. The goals, objectives, implementation, and day-to-day operation of the FRMS should be clearly documented and communicated to all stakeholders.

FRMS Policy

The policies and procedures manual defines fatigue and its associated risks and creates a common understanding within the organization about the principles and standards for dealing with fatigue-related risks. The FRMS policy helps align all organizational efforts toward the ultimate goal of improved safety. If employees are consulted throughout the development of the policy and are supportive of the process, it is more likely they will take a positive, proactive approach to fatigue risk management at the individual as well as organizational levels.

FRMS policies and procedures should:

- meet existing legal/regulatory/industrial requirements for fatigue risk management
- suit specific operational needs
- allow intra-organizational flexibility (i.e., the rules for one work group may not necessarily be the same as another within the same company)
- not place unnecessary economic burdens on organizations

Developing FRMS Policies

Studies have found that many organizations need guidance in designing FRMS policies that are both specifically suited to their operational needs and that meet regulatory approval. Transport Canada has published a companion document to this guide that offers guidelines for the development of policies and procedures (see *Policies and Procedures Development Guidelines*, TP 14576E).

FRMS policies are often developed over a period of several months. Many organizations begin by releasing an over-arching mission statement to set the framework and to underscore the backing of senior management of the organization (e.g., CEO, general manager, board members). The mission statement should also be incorporated as a single paragraph into the organization's existing SMS policy (for more information on developing the policy and mission statement, see Section 3.2 of *Policies and Procedures Development Guidelines*). In addition to stating management support, the mission statement should outline the scope, purpose, and objectives of the FRMS. The document need not be any longer than a page. An example is provided below.

ABC Company
Fatigue Risk Management Mission Statement

Add company logo

Corporate Picture

Picture of Managing Director

Picture of Company Operations

ABC Company is committed to protecting all employees, clients, and visitors from fatigue-related risk.

ABC's fatigue risk management system aims to continually improve the safety of its flight operations by managing fatigue-related risk and by ensuring that staff consider at all times the safety implications of their own fatigue, and that of their colleagues.

ABC Company's fatigue risk management policy is backed by the strongest commitment at the highest level.
(signed by managing director)

Sample FRMS Mission Statement

After announcing the support of senior management through the mission statement, the detailed design of the FRMS policies and procedures manual can begin. The responsibility for developing, implementing, and maintaining the FRMS manual should ultimately rest with the individual responsible for safety or with a more formal fatigue working group (also known as the FRMS committee). However, there should be opportunities for employees to provide input. It is important that employees understand the purpose as well as the required elements of the FRMS policy. The consultation should be undertaken by the person or committee responsible for the development, implementation, and operation of the FRMS policy.

Studies have underscored the benefits of ensuring that employees are involved in all new and ongoing policy initiatives. This not only ensures buy-in from employees, but also improves the likelihood that the goals and action plans set out in the policies are based on the true capability of the organization and its employees.

The detailed FRMS policies and procedures manual should describe the various levels of fatigue hazard controls to be put in place at the company and the related procedures for each. Usually the manual covers:

- responsibilities of employees under the FRMS
- communication and consultation processes
- hours of service and scheduling
- verification of actual sleep
- monitoring of fatigue-related symptoms
- fatigue-proofing strategies
- reporting protocols
- training and education
- review and improvement process

EXERCISE

- Describe the importance of developing an FRMS policies and procedures manual.
- Write the scope, purpose, objectives and definitions for your organization's FRMS.

CHAPTER 4

Training and Education

Learning Outcomes

On completing this chapter, you will be able to:

- Determine the fatigue training needs of your organization.
- List the resources required to support a fatigue management training program.

CHAPTER 4

Training and Education

Determining Training Needs

There are three main factors to consider when designing and implementing an FRMS training program:

1. Level of existing knowledge within the organization
2. The level of fatigue-related risk within the organization
3. Requirement of resources for training within the organization

Training is an essential component of a fatigue risk management system. Before designing and implementing a training program, an organization should determine the level and method of training required. For example, if fatigue risk management is relatively new to an organization, it may need to start with a basic training program about fatigue and how to manage it at a personal level (i.e., *An Introduction to Managing Fatigue* (TP 14572E). An organization that understands the risk of fatigue may choose to go directly to more detailed instruction about applied management strategies (i.e., *Fatigue Management Strategies for Employees*, TP 14573).

A risk assessment of the various work tasks and the work environment also helps in developing a training program. Companies with low fatigue-related risk may decide to launch a basic workplace awareness program. Companies where fatigue-related risk is high or extreme may require employees to follow competency-based training with regular refresher courses.

Another factor to take into account is the size of the organization. A small company with only 20 employees in a single location may choose to hire an external trainer to present the training package to all employees at the same time. A company with several locations may choose to use a web-based package that employees can complete in their own time and at their own location. If an organization already has an in-house safety training program, it can train its own trainers to deliver a fatigue management training program. The *Fatigue Risk Management for the Canadian Aviation Industry: Trainer's Handbook* (TP 14578E) may be useful for companies that choose this option.

Factors to consider when designing a fatigue risk management training program

Level of Fatigue Risk	Resources	Employee Characteristics
• Working hours • Work tasks • Work environment • Frequency of fatigue-related accidents • Likelihood and consequences of fatigue-related error • Regulatory requirement	• Financial commitment • Time for development • Time for implementation • Workplace culture – most effective methods of training • Availability of in-house trainers • Training materials	• Geographic location • Literacy skills • Venue • Rates and reasons for sickness/absenteeism • Current knowledge • Existing competencies

The table above provides a summary of various things to take into consideration in implementing a training program.

When the training needs and levels have been identified, it will be necessary to:

- determine the content of the training package
- determine the time frame and schedule for completion of training
- allocate the necessary resources to ensure the successful roll-out and follow-up of the course

Fatigue Management Education and Training

Fatigue training is most efficient when it provides both knowledge and know-how.

The aims of any fatigue training should be clearly stated in the course outline. The time devoted to the course should reflect the priority and importance of fatigue issues for the organization. Typically, face-to-face training can run from 60 minutes to eight hours.

In the past, organizations typically provided short educational sessions about fatigue. While such sessions are important for raising awareness, there is often a low rate of knowledge retention with this type of training. Employees may take some information away but since details are quickly forgotten, they are unlikely to alter any of their habits at work or away.

More recently, organizations have begun using competency-based training techniques, which require employees to apply what they have learned to their individual situations. This approach promotes better knowledge retention among trainees. In addition, formal competency-based assessments can assure an organization that employees understand the concepts presented and can apply them to

their work situation. Refresher training should be given annually for the first two years, and every two years after that. Refresher courses also provide an opportunity to disseminate new information from the evolving field of fatigue management and allow employees to consolidate prior learning.

The Training Environment

Investment in training can be wasted if it is not framed by a real learning environment. Employees who attend training courses may not actually know why they are there or how they will be followed up. Some managers may show little interest in helping or encouraging employees to implement changes based on their training. It is important to develop a training environment as well as a training course. An environment that promotes learning provides:

- appropriate notice for course attendance (i.e., several weeks compared to several hours)
- any prior reading required (i.e., refresher course materials, background information, etc.)
- course location and aims
- facilities for training (i.e., training room rather than lunch room, air-conditioned environment, quiet, etc.)
- training support materials and facilities (e.g., printed materials, audio-visual presentations, white board, paper, pens, etc.)
- appropriate record keeping of course attendance and future courses required
- assessment process outlined, conducted, and recorded (e.g., oral and written assessment, log book, etc.)
- support of trainees (e.g., time, resources, follow up, mentoring, etc.)
- skilled trainers and their contact information

Fatigue Management Training and Education Outcomes

On completion of training, it is expected that:

- Employees know and understand the organization's fatigue management policies and procedures.
- Managers and employees know and understand their responsibilities in managing fatigue.
- Personnel know how to identify and manage risks associated with fatigue at both a personal and organizational level.
- Those responsible for decisions influencing sleep opportunities for employees know and understand their responsibilities and implement appropriate fatigue-reduction strategies where necessary.
- Training records have been made and stored in an appropriate place.

EXERCISE

- Determine the need for fatigue training within your organization.
- Develop a training program for the organization.
- Develop a training report that you would present to senior management; within this report, identify (1) resources required, (2) training times, and (3) trainer to conduct the fatigue training course for employees.

CHAPTER 5

Level 1 Controls: Providing Sufficient Sleep Opportunity

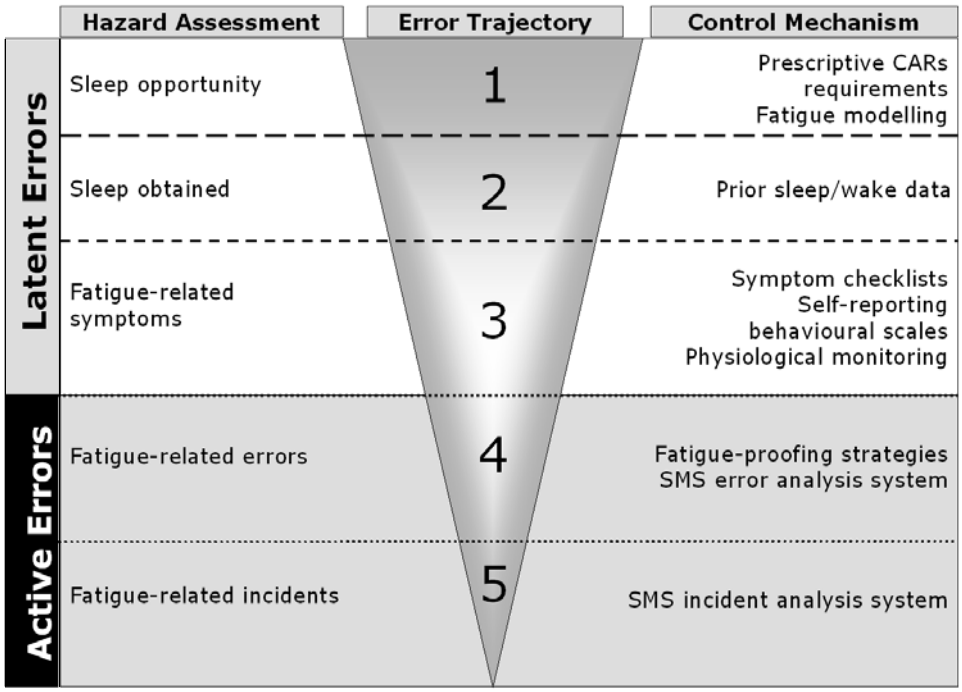
Learning Outcomes

On completing this chapter, you will be able to:

- Describe the characteristics of a schedule that would increase the likelihood of work-related fatigue.
- Assess the scheduling practices of your organization with respect to mental fatigue.

CHAPTER 5

Level 1 Controls: Providing Sufficient Sleep Opportunity



Hazard-Control Model for Fatigue Risk Management

In the past, fatigue has been largely managed through scheduling regimes, usually through rules governing hours of work imposed by regulators, organizations, or union bodies. In a fatigue-risk management system, however, there are five major levels of control: organizational, individual, behavioural, error, and incident level. A successful fatigue risk management system addresses each of these levels by organizing defence systems around these layers. This chapter addresses Level 1 of the hazard control model.

Level 1 controls are aimed at ensuring that the work schedule provides employees with sufficient sleep opportunity. To achieve this, the following factors should be considered:

- length and timing of shifts
- length and timing of breaks
- number of shifts worked in a row
- number of days off between shifts

Using factors such as these, an organization can predict, on average, how much sleep an employee will obtain. This chapter provides an overview of some strategies for assessing work schedules and their impact on sleep, alertness, and fatigue.

Assessing Schedules for Adequate Sleep Opportunity

The major reason for assessing work schedules, apart from ensuring that they comply with industry requirements and other rules, is to understand the likely impact that specific hours of work have on sleep opportunity. Sleep is the only cure for fatigue. In the context of an FRMS, the employer has the responsibility to ensure that adequate opportunity is provided for sleep between work shifts. It is the employee's responsibility to use the opportunities given to obtain recovery sleep.

Most people need between seven and nine hours sleep to maintain safe performance and alertness levels. Depending on the time of day that a break is provided, the amount of time off needed to get adequate sleep could be as little as 10 hours and as much as 20 or more. This reflects the fact that employees do not simply fall asleep as soon as they leave work and wake just before they return. People have many activities and responsibilities to manage between shifts such as commuting to and from work, eating, showering, socializing, relaxing, spending time with family and friends, etc. To ensure adequate rest, sleep opportunity needs to include time for employees for recovery sleep and other activities.

Work schedules may be assessed by examining specific aspects of the hours of work. The questions provided below can be used as a guide, but they should not be seen as a complete list for all circumstances. Sleep opportunity alone should not determine appropriate schedules, even though it is generally the most important factor. For example, early morning start times generally produce higher levels of fatigue, but a 5 a.m. start may be more appropriate than working under extremely hot and humid conditions in the afternoon. This reflects the risk-based approach of safety management systems (as discussed in Chapter 3).

The following are some questions that could be asked to assess sleep opportunity and potential fatigue:

a. How many hours are worked per seven-day period? Not surprisingly, as total hours worked increase, sleep opportunity decreases.
b. What is the maximum shift length? As the length of a given shift increases, the subsequent sleep opportunity decreases.

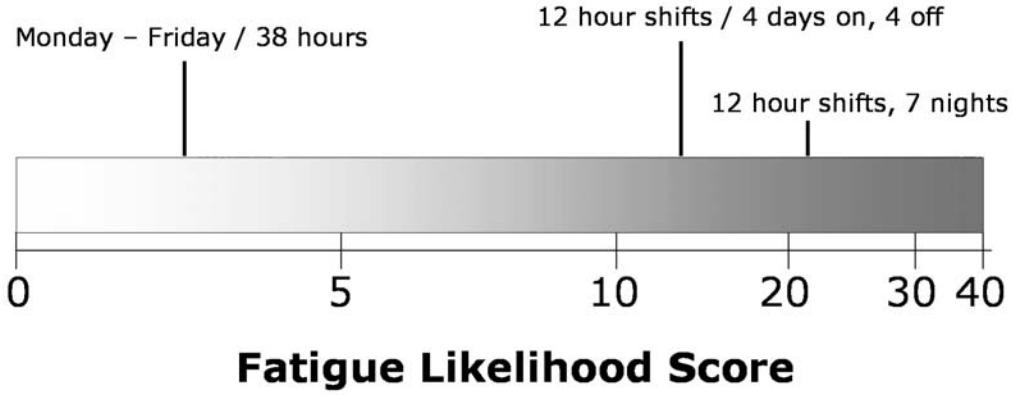
c. What is the minimum length of time off between shifts? A short break is defined as a single sleep opportunity between subsequent work periods. It is typically a period of less than 32 hours. Not surprisingly, as the break between subsequent shifts decreases so does the sleep opportunity.
d. How many hours are worked between 9 p.m. and 9 a.m.? This question considers late finishes, early starts and night work. All of these will reduce night sleep opportunity and result in a significant reduction in total sleep opportunity.
e. How often do employees get a long break from work? A long break is defined as a period of two night sleeps with a non-working day in between. Long breaks typically provide a significant opportunity to recover from sleep loss accumulated over a series of shifts.

The table below provides an example of how questions like those above can be quantified into a rule system.

Fatigue Likelihood Scoring Matrix for Work Schedules

Score	0	1	2	4	8
a) Total hours per 7 days	< 36 hours	36.1 – 43.9	44 – 47.9	48 – 54.9	55+
b) Maximum shift duration	< 8 hours	8.1 – 9.9	10 – 11.9	12 – 13.9	14+
c) Minimum short break duration	> 16 hours	15.9 – 13	12.9 – 10	9.9 – 8	< 8
d) Maximum night work per 7 days	0 hours	0.1 – 8	8.1 – 16	16.1 – 24	> 24
e) Long break frequency	> 1 in 7 days	< 1 in 7 days	< 1 in 14 days	<1 in 21 days	< 1 in 28 days

In the table above, a 9 a.m. to 5 p.m. work week (5 days in a row) would produce a score of zero. On the other hand, a work schedule of seven 12-hour night shifts, followed by seven days off would produce a score of 21, which would be considered high. The figure below shows examples of schedules scored using this approach.



Examples of different schedules scored using the Fatigue Likelihood Scoring Matrix

Calculating a score for a schedule allows companies to quantify what they deem to be acceptable or unacceptable. The cutoff score for an acceptable schedule will be determined by the specific characteristics of the organization. For example, an organization could choose to assign a lower cutoff score for highly complex or safety-critical work, or for a high-stress work environment (e.g., high humidity) than for less critical work in an air conditioned environment.

In the beginning, cutoff scores will be best estimates. However, as an organization's understanding of its own fatigue hazard improves through collecting data on actual sleep (see Chapter 7) and fatigue-related errors, it should reassess scores that show signs of providing insufficient sleep opportunity.

Fatigue Modelling

Although fatigue cannot be measured like alcohol or drug impairment, there are ways it can be assessed. Work schedules can be used to predict fatigue based on the likely sleep loss caused by a specific shift pattern. Predictive software models can provide fatigue likelihood scores on the basis of a schedule.

Many models predict fatigue based on planned or actual hours of work. In doing

so, they consider a number of factors known to be relevant for work-related fatigue. These factors include the timing and duration of all previous work shifts (with more weight given to the most recent shifts). Most models also allow comparison of the fatigue scores that various schedules may impose on an employee population. In addition, organizations can set different threshold values for fatigue likelihood scores, based on a risk assessment of tasks within their operation. In other words, a score may be designated acceptable for low-risk tasks, but unacceptable for tasks that involve a much higher potential safety risk. One limitation of such a system, however, is that it does not tailor predictions for every single employee.

As with any fatigue management tool, testing devices and models should form part of an integrated system, not replace it. Each organization should understand the likely impact of fatigue in the context of the work tasks that its employees perform.

Designing the Ideal Shift System

It is important to understand that there is no such thing as a "perfect" work schedule. There are always a multitude of factors to consider. For example, while managing fatigue and providing sufficient sleep opportunity is important, it is also important to ensure employees receive sufficient family and social time away from work. The ideal schedule would be from 9 a.m. to 5 p.m. However, in today's world of 24-hour demand and supply, companies often require employees to work outside these hours.

A fatigue-friendly schedule would ensure that all shifts are finished between nine and ten o'clock at night so employees could go home and easily get eight hours of sleep without having to wake up too early. However, such a schedule leaves little time for socializing or spending time with family, and could lead to feelings of social isolation and depression.

A social-friendly schedule, on the other hand, would have employees starting work in the early hours of the morning and finishing mid-afternoon to enable them to spend time with family and friends. However, since it is unlikely that an employee would go to bed before ten or eleven o'clock at night, this type of schedule significantly limits the opportunity for sleep before the next shift.

The ideal shift for one employee is not likely to satisfy all employees. For example, a schedule that suits an employee with two young children would be unlikely to suit another employee who likes to sleep in and stay up late. While sleep should be the primary concern, other factors (such as family and social life) should also be considered when designing new shift systems.

Considerations to Maximize Sleep Opportunity in Designing Work Schedules

As discussed in Chapter 1, prescriptive rules based solely on schedule design may be appropriate for ensuring recovery

from physical exhaustion. However, they are of limited benefit in managing mental fatigue. More effective strategies for reducing physical and metal fatigue focus instead on the time available for sleep (or sleep opportunity) and actual sleep obtained (see next chapter).

Things to consider in designing work schedules include, but are not restricted to:

- limiting night shifts
- reducing shift length to 12 hours or less
- limiting early morning starts
- limiting extended duty hours/overtime
- recording and controlling overtime
- ensuring appropriate breaks during shifts (coffee, meals, etc.)
- providing sufficient time off between shifts to allow for minimum sleep requirements
- limiting long blocks of work (i.e., multiple days worked one after the other)
- planning as much of the actual hours of work as possible
- creating a napping policy and facilities, including a process for managing sleep inertia

EXERCISE

- List some of the main characteristics of a work schedule that increases the likelihood of obtaining sufficient sleep between shifts.
- What score would your typical work schedule produce on the Fatigue Likelihood Scoring Matrix?
- Explain why you might choose a computer-based modelling tool over prescriptive hours-of-work rules.

CHAPTER 6

Level 2 Controls: Assessing Actual Sleep

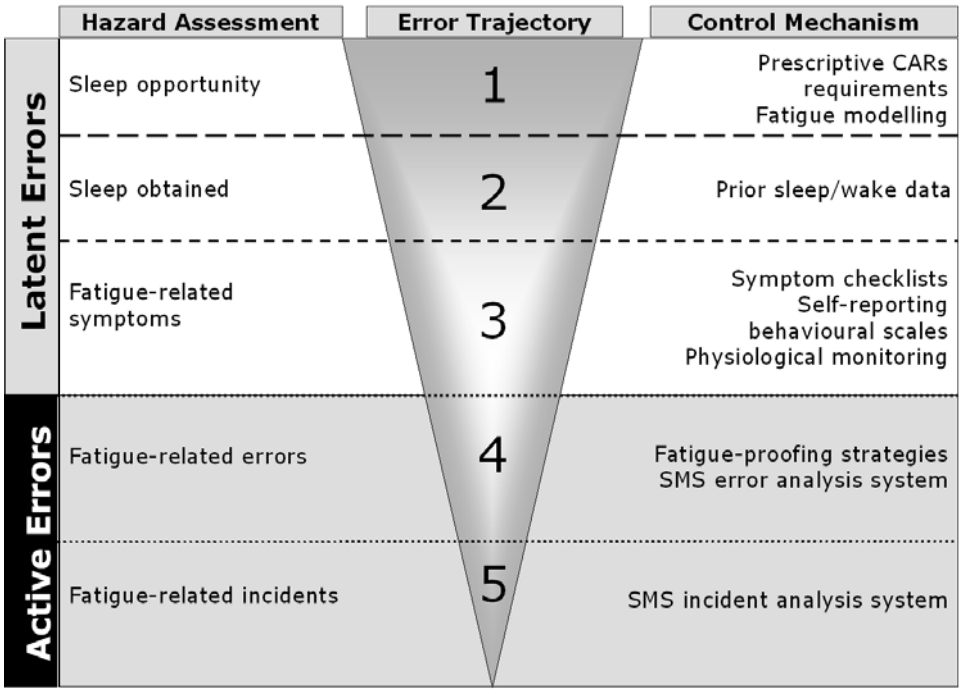
Learning Outcomes

On completing this chapter, you will be able to:

- Identify employees who are at risk for fatigue-related impairment.
- Identify some of the reasons why employees may not obtain sufficient sleep.
- Describe potential processes for dealing with employees who have had insufficient sleep.

CHAPTER 6

Level 2 Controls: Assessing Actual Sleep



Hazard-Control Model for Fatigue Risk Management

Level 1 controls presented in the previous chapter are intended to provide adequate sleep opportunities to employees. However, the organization has little control over what employees actually do or, specifically, how much sleep they actually obtain after they leave the workplace. Level 2 controls are aimed at ensuring that employees get adequate sleep whenever they are provided sufficient sleep opportunity. This level of control is aimed at the individual level rather than at the organizational level.

Level 2 controls play two main roles within the fatigue risk management framework:

- They identify employees who, even given sufficient sleep opportunity, fail to obtain sufficient sleep.
- They can be used to assess the effectiveness of Level 1 controls.

While Level 1 controls provide an indication of the quantity of sleep *likely* to be obtained, it is important to know whether there is still a risk of fatigue at the individual level.

There are a number of reasons why employees may not get sufficient or sufficient quality sleep. Some may not be within the employee's control. For example, parents with a newborn baby are likely to get reduced amounts of sleep. An employee with a partner who is a chronic snorer may be awakened periodically throughout the night. An employee with a business on the side may suffer from reduced sleep opportunity. Insomnia or life stress may keep an employee awake at night. An employee working night shift may simply be unable to sleep during the day. Or, an employee may be irresponsible and put social time and partying ahead of obtaining sufficient sleep to ensure fitness for duty. Regardless of the circumstances causing insufficient sleep, fatigued employees should be identified and treated as a potential workplace hazard.

Before discussing different kinds of action to take when employees do not get enough sleep, it is important to quantify "sufficient" sleep. How much sleep each person needs every 24 hours to perform optimally varies – in general it is between seven and nine hours. Research has found that a person can maintain alertness and performance for a single day on approximately six hours sleep. However, more sleep is needed on average over two or more nights, or performance – and safety – are likely to decline significantly. Even a few nights of five or six hours of sleep is likely to result in poorer performance, communication, and functioning in most individuals.

Another factor that should be considered in addition to total sleep time is the time since an employee last had a sleep or nap (i.e., length of time awake). Considerable scientific evidence suggests that the longer an individual has been awake the poorer their capacity. This is especially true if the total time since the last sleep or nap extends beyond 16 or 18 hours.

There are various ways to assess the sleep employees obtain. With the agreement of employees – and any other stakeholders, such as unions – companies may decide to set up a system where employees calculate for themselves how much sleep they have had and how long it has been since their last sleep period or nap. Employees may be required to report when their sleep or time awake doesn't meet the requirements. For example, in a high-risk operation it might be agreed that any employee who has had less than 6 hours of sleep in 24 hours, or 12 hours of sleep in 48 hours, or has been awake for longer than 18 hours, must report to the supervisor. A simple method of calculating whether an employee is likely to be fatigued based on sleep and time awake is illustrated below.

Individual Fatigue Likelihood

Step 1. Sleep in prior 24 hours

Sleep	<2h	3h	4h	5+h
Points	12	8	4	0

Step 2. Sleep in prior 48 hours

Sleep	<8h	9h	10h	11h	12+h
Points	8	6	4	2	0

Step 3. Hours awake since last sleep

Add one point per hour awake greater than sleep in step 2.

Individual Fatigue Likelihood

Step 4.

Add all points together to determine your score

Score	Control Level
1-4	Self-monitoring
5-8	Supervisor monitoring
9+	Don't start shift until fit for work

Refer to FRMS policy for detailed explanation of controls

Individual fatigue likelihood score (IFLS) is a calculation based on time asleep and awake

This calculation tool can be printed on a wallet-sized card for easy reference by employees and managers.

A company may also decide that employees can, within reasonable limits, assess their own requirements for sleep and report to their supervisor when they do not meet minimum limits. This simple and practical process can flag sleepiness and fatigue issues before they lead to an incident.

When employees report to a supervisor that they have had insufficient sleep, it is important that clear procedures be in place to manage the risk in a consistent manner. This helps managers perform their duties and ensure that decision-making is based on clearly understood rules. The countermeasures to adopt should take into account the level of risk inherent in the tasks involved. The example below illustrates six possible scenarios of insufficient sleep that would require different actions by management.

On reporting:

- **Six hours sleep in the previous 24 hours, and 12 hours sleep in the previous 48**: the employee might be instructed to go to work as normal.
- **Five hours sleep in the previous 24 hours, and 11 hours sleep in the previous 48 hours**: the employee might be instructed to continue work, but to closely monitor fatigue-related behaviours or symptoms.
- **Five hours sleep in the previous 24 hours, 11 hours sleep in the previous 48 hours, and 18 hours awake**: the employee might be instructed to take a nap and have a strong cup of coffee on waking up to minimize the risk of fatigue.
- **Four hours sleep in the previous 24 hours and ten hours sleep in the previous 48 hours**: the employee might be instructed to have a strong cup of coffee, and work under close supervision of colleagues and managers.

- **Four hours sleep in the previous 24 hours, and eight hours sleep in the previous 48**: the employee might be assigned to less critical tasks to minimize the consequence of potential errors.
- **Two hours sleep in the previous 24 hours and five hours sleep in the previous 48 hours**: employees might be told to stop work, and either go home to sleep (if they live close by) or take a nap on the premises because they are unfit to drive.

Sleep thresholds are likely to vary from organization to organization, task to task, and individual to individual. If the threshold is set too low, it will be picked up by the subsequent levels of the hazard control system. For example, if employees are getting the recommended minimum amount of sleep (e.g., six hours per night), but still exhibit fatigue behaviours and symptoms (see Chapter 7), and if they are not suffering from a sleep disorder, it is likely that the minimum level of sleep is insufficient. Each organization – or even work group – should establish its own sleep thresholds and decision trees for when employees have not met the sleep requirements.

Assessing Adequacy of Level 1 Controls

Level 2 controls allow an organization to verify whether Level 1 controls for providing sufficient sleep opportunity are adequate. For instance, if numerous employees report insufficient sleep, the organization should reassess the sleep opportunity provided by the work schedules. On the other hand, if only a few fail to obtain a sufficient sleep, it may be because of non-work related reasons, rather than an issue with the sleep opportunity provided by the work schedule. With appropriate record-keeping procedures, reporting insufficient sleep can help organizations take a performance management approach to employees who consistently report difficulties in this area. The underlying reasons for each case should be investigated. It might be that the employee has a medical problem (e.g., insomnia, physical injury, or a bad cold) or that some life circumstance is negatively affecting sleep (e.g., personal stress, sickness in the family, noisy neighbourhood).

If an employee repeatedly does not take the necessary measures to obtain sufficient sleep, further action may be required. An organization may choose to address the issue using an approach similar to that used for any other problem that may affect performance, such as drug or alcohol abuse. This can be dealt with through discussions with the employee, agreements on measures to be taken, and a series of warnings that could even eventually lead to dismissal.

EXERCISE

- How much sleep is required by most people to maintain alertness during a work period?
- List two questions you would ask an employee whom you think may not be getting enough sleep. What information would you seek with these questions?
- What actions would you take if an employee has had insufficient sleep?

CHAPTER 7

Level 3 Controls: Assessing Symptoms of Fatigue

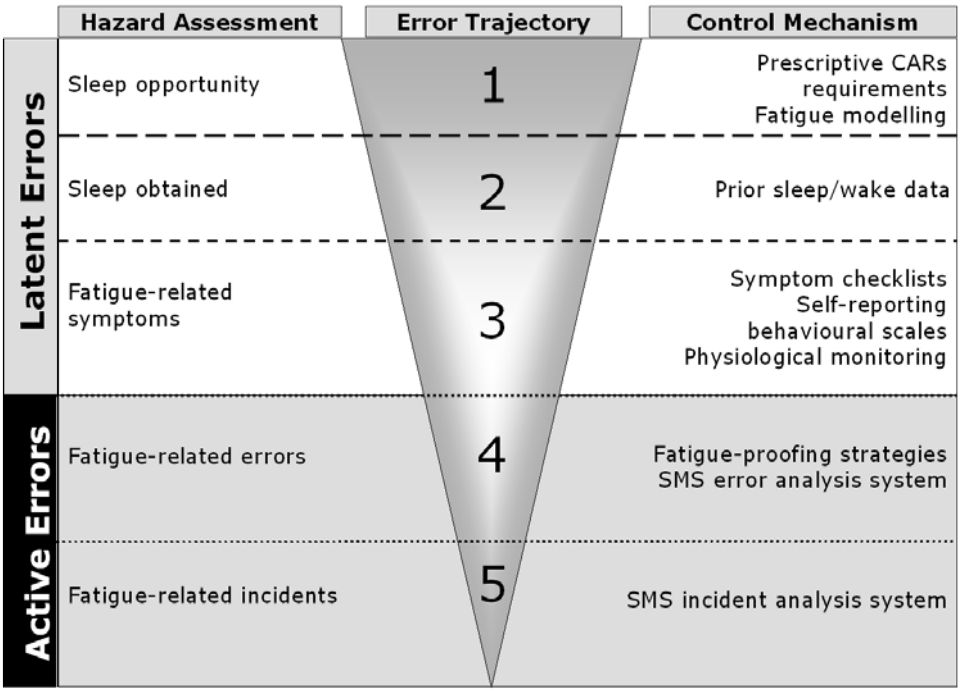
Learning Outcomes

On completing this chapter, you will be able to:

- Explain the purpose of including fatigue-related symptom checklists within an FRMS.
- Recognize symptoms of fatigue-related impairment.
- Describe some of the major sleep disorders.
- Outline appropriate action to be taken by a company if an employee is thought to suffer from a sleep disorder.

CHAPTER 7

Level 3 Controls: Assessing Symptoms of Fatigue



Hazard-Control Model for Fatigue Risk Management

Even when sufficient sleep opportunity has been provided (Level 1 controls) and employees feel they have obtained sufficient sleep (Level 2 controls), they may still show fatigue-related symptoms. Level 3 controls assess individual employees for symptoms that could lead to fatigue-related error.

Level 3 controls play two main roles:

1. Identify employees who continue to exhibit fatigue-related symptoms, despite getting sufficient sleep.
2. Assess the effectiveness of Level 1 and 2 controls. For example, where employees fail to report they did not

get enough sleep, monitoring for fatigue-related symptoms adds an additional layer of defence.

Identifying At-Risk Individuals

Fatigue-related symptoms can be divided into three categories: physical, mental, and emotional. The table below outlines some of the major symptoms under each category. If employees experience three or more of the symptoms outlined below, they may be experiencing some level of fatigue or reduced alertness. Fatigue is not the only cause of the symptoms presented below, but when they occur together it likely indicates fatigue-related impairment.

An employee who presents three or more symptoms in a short period of time is likely to be experiencing fatigue-related impairment.

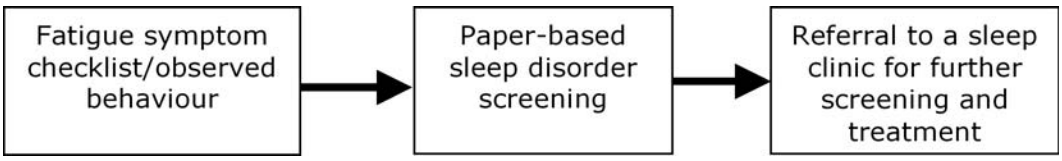
Physical Symptoms	Mental Symptoms	Emotional Symptoms
• Yawning • Heavy eyelids • Eye-rubbing • Head drooping • Microsleeps	• Difficulty concentrating on tasks • Lapses in attention • Difficulty remembering what you are doing • Failure to communicate important information • Failure to anticipate events or actions • Accidentally doing the wrong thing • Accidentally not doing the right thing	• More quiet or withdrawn than normal • Lacking in energy • Lacking in motivation to do the task well • Irritable or grumpy with colleagues, family or friends

Many companies teach employees how to identify symptoms, both in themselves and others, that may indicate an increased risk of making a fatigue-related error. Raising awareness about the signs and symptoms of fatigue can be an effective strategy to reduce the number and severity of fatigue-related errors and incidents.

To further reinforce the importance of monitoring fatigue-related symptoms, employees can be provided with aids, such as a checklist to be filled out at the start of every shift, or a wallet-sized card listing the most common symptoms to watch out for.

If employees consistently exhibit fatigue-related behaviour, potential reasons should be investigated. It may simply be that the employee has a personal problem (e.g., sickness in the family, new child or concern, or poor sleeping environment). Employees who say they get enough sleep and cannot explain their fatigue-related symptoms should undergo screening for a sleep disorder. The first step is some kind of paper-based screening, such as a questionnaire, to determine whether they are at risk. At-risk employees should then be referred to a sleep clinic.

Another way to check how fatigued employees feel is to ask them to rate their alertness at various intervals within a shift. The Karolinska Sleepiness Scale[3] can be used to determine whether fatigue is a problem for an individual without determining the root cause for the lack of sleep. As shown below, the scale requires employees to select the statement that best describes them at the time. The scale can be used as an assessment of sleepiness/fatigue at any point in time: at work, while driving, on waking in the morning, etc.



Screening for Sleep Disorders

Karolinska Sleepiness Scale

1. Extremely alert
2. Very alert
3. Alert
4. Rather alert
5. Neither alert nor sleepy
6. Some signs of sleepiness
7. Sleepy, but no effort to keep awake
8. Sleepy, some effort to stay awake
9. Very sleepy, great effort to keep awake, fighting sleep

[3] Åkersted, T., & Gillberg, M. (1990). Subjective and objective sleepiness in the active individual. *International Journal of Neuroscience*, 52 (1-2), 29-37.

Employees who report fatigue-related symptoms on a regular basis may have a sleep disorder. An example of a paper-based test to identify the severity of fatigue is the Epworth Sleepiness Scale[4], which asks individuals to determine how likely they are to fall asleep or doze off during a variety of activities. Subjects are instructed to provide answers based on their usual way of life over the past several months. Even if they have not done some of these things recently, they are instructed to try and work out how they might have been affected in each situation. Employees who score above 10 are likely to have problems with their sleep patterns and should be referred to a sleep specialist.

Epworth Sleepiness Scale

Situation	**Chance of dozing**
Sitting & Reading	
Watching TV	
Sitting inactive in a public place (e.g. theatre)	
As a passenger for an hour without a break	
Lying down to rest in the afternoon	
Sitting & talking to someone	
Sitting quietly after lunch without alcohol	
In a car, while stopping for a few minutes in traffic	
Total Score	

0 = would never doze
1 = slight chance of dozing
2 = moderate chance of dozing
3 = high chance of dozing

A score of less than 8 indicates normal sleep function

8-10 = mild sleepiness
11-15 = moderate sleepiness
16-20 = severe sleepiness
21-24 = excessive sleepiness

[4] Johns, M. W. (1991). A new method for measuring daytime sleepiness: the Epworth sleepiness scale. *Sleep*, 14 (6), 540-545.

There are several types of sleep disorder that affect daytime functioning. A polysomnographic (PSG) recording of sleep at a sleep clinic can help determine the root cause of the fatigue. This process includes analysis of electrical brain activity, eye movements, and breathing throughout the sleep period.

Some of the major sleep disorders are outlined below. Any of these conditions can result in bouts of daytime sleepiness, reduced alertness, and overall lack of energy. Physicians trained in sleep medicine are best equipped to diagnose and treat these problems. A primary care physician should be able to refer clients to a sleep specialist for evaluation, diagnosis, and treatment.

Insomnia

Insomnia is a disorder characterized by difficulty falling or staying asleep, and/or frequent awakenings during the sleep period. There are a number of factors that may contribute to insomnia, including (but not limited to):

- short-term or long-term stress such as trauma or chronic illness
- psychological condition
- the presence of another sleep disorder
- poor sleep hygiene (i.e., not following good sleep practices)

Sleep Apnea

Sleep apnea causes a person to stop breathing for brief periods several times during sleep. This condition can affect all ages and both genders, but it is most common in men and is particularly prevalent in obese people. The disorder exists in two forms:

1. *Obstructive sleep apnea* is the most common and occurs when the airways close while a person is sleeping, blocking the flow of air and preventing adequate oxygen flow to the body. This awakens the sleeper many times a night, disrupting the normal structure of sleep, and resulting in sleepiness and reduced alertness at work.
2. *Central sleep apnea* is less common and occurs when muscles required for breathing do not receive a signal from the brain, causing the sleeper to stop breathing.

Untreated sleep apnea can lead to cardiovascular tissue damage caused by reduced oxygen levels and can lead to excessive sleepiness when a person is awake. Excessive sleepiness can lead to accidents and injuries, particularly while driving or operating safety sensitive systems.

Restless Leg Syndrome and Periodic Limb Movement

Restless Leg Syndrome and Periodic Limb Movement are sleep disorders that are characterized by involuntary limb movements, usually a leg, many times over the course of a night. Movements can occur as often as every 10 seconds, disrupting sleep and leaving the individual suffering significant daytime sleepiness.

Narcolepsy

Narcolepsy is characterized by a sudden irresistible desire to go to sleep that lasts from minutes to hours at a time. It is associated with cataplexy (the sudden loss of tone in one or more muscle groups) and with vivid auditory or visual hallucinations when falling asleep. This is understood to be a malfunction of the mechanism that controls rapid eye movement (dreaming) sleep. Excessive daytime sleepiness and the tendency to fall asleep uncontrollably may render individuals unable to carry on working, and may put themselves or others at risk.

Sleep Clinics

An employee suspected of having a sleep disorder should be encouraged to consult a sleep specialist. Usually, the employee will need a doctor's referral. The Canadian Sleep Society offers a list of sleep medicine clinics in Canada: www.css.to/sleep/centers.htm.

Assessing the effectiveness of other levels of control

In Chapter 6, we discussed Level 2 controls (i.e., obtaining sufficient sleep) as they related to Level 1 controls (providing sufficient sleep opportunity). We established that assessing the actual amount of sleep obtained provides a measure of how effective the Level 1 controls are in providing sufficient sleep opportunity. In the same way, Level 3 controls offer a way to measure the effectiveness of the two previous levels of control.

In Chapter 2 we discussed organizational and individual responsibilities in managing fatigue. The organizational responsibilities included two subcomponents:

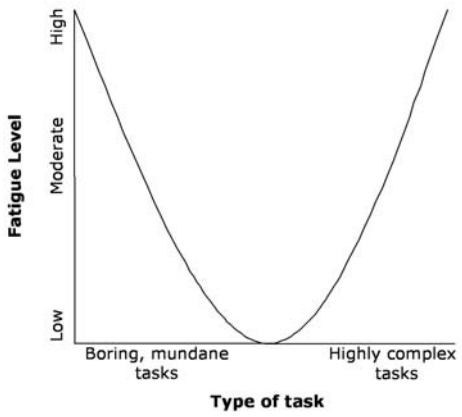
1. Fatigue related to hours of work
2. Fatigue related to workload and environment

Fatigue related to hours of work should be managed by providing employees with sufficient sleep opportunity between shifts (Level 1 controls). Assessing actual hours of sleep (Level 2 controls) lets you double-check that sleep opportunity is sufficient.

Some employees may find it difficult to quantify how much sleep they actually get, particularly if sleep is disturbed. Some may also choose to be dishonest about the actual amount of sleep they obtain and fail to report when they may be at risk of fatigue-related error. Level 3 controls (monitoring for fatigue-related behaviours or symptoms) provide a further check to ensure that sufficient sleep opportunity has been provided (Level 1) and that employees are obtaining sufficient sleep (Level 2).

The tasks involved in a job can significantly affect fatigue. Some tasks are more fatiguing than others. As shown in the figure below, this can occur at both ends of the spectrum – mundane tasks can be just as fatiguing as highly complex, demanding tasks.

Similarly, some aspects of the work environment can affect fatigue more than others. For example, fatigue-related behaviour tends to be more prevalent in workplaces that have high levels of vibration or noise, or high temperatures. The level of lighting (lux) in a workplace can also affect fatigue. Since these factors would not be identified in the Level 1 or 2 controls, watching for specific fatigue-related symptoms in the workplace provides an additional level of control to further enhance the safety management system.



Relationship between Task Complexity and Fatigue

EXERCISE

- Describe the role of Level 3 controls in an FRMS.
- List seven signs or symptoms of fatigue.
- Describe two of the major sleep disorders.

CHAPTER 8

Level 4 and 5 Controls: Fatigue Proofing and Reporting Incidents and Accidents

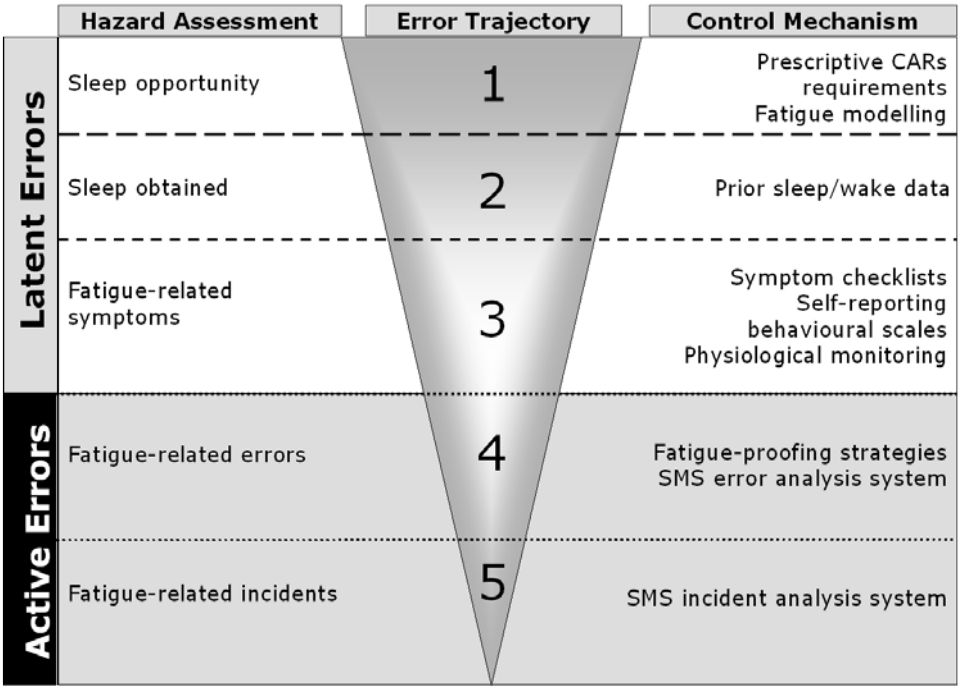
Learning Outcomes

On completing this chapter, you will be able to:

- Choose fatigue-proofing strategies that would be useful for your organization.
- Understand the reasons why most organizations' incident and accident investigation procedures do not properly identify fatigue as a contributing factor in a specific event.
- Identify the two necessary conditions that define an event as a fatigue-related incident or accident
- Outline specific trends that can be assessed to identify potential patterns between incident and accident data and fatigue factors.

CHAPTER 8

Level 4 and 5 Controls: Fatigue Proofing and Reporting Incidents and Accidents



Hazard-Control Model for Fatigue Risk Management

Even with strict controls in place, it is still possible that fatigue-related errors could occur and result in incidents or accidents. Level 4 and 5 controls are designed to further reduce fatigue-related risk.

Level 4: Fatigue-Proofing Strategies

The goal of an FRMS should be to reduce fatigue levels as much as reasonably possible. Achieving this goal involves focussing on the time available for sleep

(or sleep opportunity) and actual sleep obtained. However, it is important to acknowledge that it is not possible to completely eliminate fatigue from all workplaces all of the time. Employees and managers should also understand that a certain amount of fatigue in the workplace may be acceptable, provided the risks are managed.

Many organizations supplement fatigue reduction strategies with fatigue-proofing strategies. Both types of countermeasures are important defences against latent failures – a series of breakdowns in the system that build up to create the conditions for an incident. They also act to further reduce the risk of active failures – the direct causes of an incident.

Once an analysis of the work schedule has been completed using work design principles, computer-modelling techniques, assessment of sleep patterns, or other approaches, the organization can target the areas of highest fatigue in the schedule with fatigue-proofing strategies. This approach encompasses four main components, including:

- "double-checking" to increase the likelihood of detecting errors
- improving the work environment to reduce risk
- scheduling less complex or less safety-critical tasks at times of highest fatigue risk
- training employees about personal limitations and strategies to increase alertness

More specific examples of fatigue-proofing strategies might include:

Double-Checking

- close supervision
- working in pairs or teams depending on the task
- task rotation
- checklists
- self-assessment checklists for signs and symptoms of fatigue
- support for new personnel by experienced personnel
- self-reporting systems
- communication/briefings at shift handovers (written/verbal/face-to-face)

Work Environment

- self-selected break times
- interaction with peers
- provision of appropriate facilities for break time: lunch room, access to vending machines with healthy snacks, caffeinated drinks, etc.
- napping facility in a quiet environment
- appropriate lighting
- control over temperature
- vibration management
- car pooling (minimize driving alone on commute)
- provision of transport (bus, taxi, etc.) for personnel for commutes after overtime (longer or extended shifts; call-ins, etc.)

Scheduling Less Complex or Less Safety-Critical Tasks

- ensure high-risk activities are conducted during the day, rather than at night, where possible
- rotate tasks
- avoid boring and mundane tasks at times of higher risk for fatigue
- maintain appropriate staffing levels
- avoid highly complex tasks at times of higher risk for fatigue

Training Programs and Topics

- fatigue awareness/competency training
- refresher training and capacity building
- training on maximizing sleep and alertness
- information for families/housemates on facilitating sleep at home
- awareness about the impact of food and hydration on alertness
- physical activity
- appropriate use of stimulants such as NoDoze
- availability of caffeine

Level 5: Incident Investigation – Asking the Right Questions

Incidents and accidents that an organization records for safety audits may include errors, near-hits (or near-misses), lost-time injuries, medically treated injuries, breaches of policy or procedure, etc. While error and incident reporting is common, until recently few reporting procedures systematically examined whether fatigue was a contributing factor.

A better understanding of fatigue risks and how they contribute to hazards in operational environments now makes it possible to include an assessment of fatigue and shift work as part of the investigation process.

It is now generally held that for an incident or accident to be defined as fatigue-related, it must have both:

- occurred in the presence of fatigue

and

- been consistent with fatigue-related error (i.e., caused by falling asleep, inattention, delayed reaction time, error in judgement, etc.)

Defining an event as fatigue-related should involve a review of the first three levels of fatigue risk control. This permits determining whether:

- the work schedule provided sufficient sleep opportunity for the employee
- the employee actually obtained sufficient sleep
- fatigue-related symptoms were observed prior to the event

The results of this review should allow you to determine whether fatigue may have been involved and to identify weaknesses in the fatigue-risk control measures in place in the organization.

Many companies analyse information from individual incident reports as well as other company sources. For example, the incident investigation process might require asking employees whether they have recently used medications known to have an effect on alertness. Or they may

be asked about the most recent break during the shift – how long was it and when did it occur? Other organizational information might include hours worked on the day of the incident and during the previous week.

The questions asked during an investigation can help determine whether a specific factor contributed to an incident. To get a clear understanding of whether fatigue contributed to an incident or accident, investigators must ask sufficient questions, and specific questions. By collecting pertinent information about fatigue, the company can improve understanding of its own fatigue risk and adjust its procedures to reduce that risk.

The list below provides a range of general questions that might be included. This is not intended to be an exhaustive list for all organizations. Each question is linked to the various levels of FRMS control, which can allow an organization to identify where corrective measures may be needed. Bear in mind that even if no evidence of fatigue is found in the answers to the questions, fatigue may still have been a factor – there are many contributors to fatigue and further probing may be necessary.

Sample questions:

1. What was the date and time of the incident/accident?
2. What were the planned hours of work for each employee involved in the incident/accident over the two weeks prior to the incident? [Level 1 controls]
3. What were the actual hours of work of employees involved in the incident/accident over the two weeks prior to the incident? [Level 2 controls]
4. What were the reasons for any additional hours worked beyond the planned hours during this period? Specifically, was the extra work or overtime foreseeable in advance and how was it allocated among all eligible employees? [Level 2 controls]
5. How many hours sleep did each employee involved in the incident/accident recall having obtained in the 24 and 48 hours prior to the event? [Level 2 controls]
6. How long had each employee involved been awake at the time of the incident/accident? [Level 2 controls]
7. Were any of the employees observed falling asleep or otherwise struggling to remain alert in the week prior to the incident/accident? If yes, document details. [Level 3 controls]
8. Does anyone involved in the incident recall having unexpectedly fallen asleep or otherwise struggling to remain alert during the week prior to the incident/accident? If yes, document details. [Level 3 controls]
9. Did anyone involved in the incident/accident take medications or drugs (prescription or non-prescription) in the week prior to the event? If yes, then document details and note any effect the medication or drug is known to have on sleep, alertness, and/or fatigue. [Level 3 controls]
10. Was any employee involved aware of any sleep or other medical disorder that might have affected sleep, alertness, and/or fatigue? If yes, document details. [Level 3 controls]

11. Was any employee involved aware of any personal, financial, or other stress that might have affected sleep, alertness, and/or fatigue? If yes, then is this stress ongoing? Document details.
12. Did any employee involved have another job or significant responsibility in the preceding two weeks? If yes, document details.
13. Approximately how many minutes is the commute to and from work for each employee involved in the incident or accident?

Answers to some of these questions may identify areas that need to be probed further. For instance, if the answers to questions related to Level 2 controls indicate that insufficient sleep was obtained, any measures that were taken to mitigate fatigue risk should be re-examined (as discussed in Chapter 6).

By assessing the information collected using such questions, companies can gain a much clearer understanding of whether fatigue contributed to an incident or accident. Over time, results of investigations can be used to examine trends between incidents/accidents and time of day, day of week, time of year, amount of overtime, commute distance, age of employee, presence of stressors, and other relevant factors. Properly collected incident and accident investigation data can permit the company to develop more stringent and targeted controls to reduce the risk of further accidents.

EXERCISE

- List five fatigue-proofing strategies that would be practical for your organization.
- Discuss why many organizations' incident and accident investigation processes are inadequate for assessing the contribution of fatigue.
- List the two necessary conditions to define an event as a fatigue-related incident or accident.
- List at least two incident or accident investigations in your organization that identified fatigue as a possible contributor. Detail any specific fatigue-related factors, such as schedule, hours worked, and symptoms of fatigue observed. If there are no recorded events identified with fatigue, comment on the likely effectiveness of your organization's system to measure relevant fatigue factors.
- Given the nature of the operations on the site(s) where you work, discuss areas that you believe would be most susceptible to fatigue-related risks and why.
- Outline specific trends that could be investigated to identify potential patterns between incident and accident data and fatigue factors.

CHAPTER 9

Internal FRMS Audit

Learning Outcomes

On completing this chapter, you will be able to:

- Detail the fatigue-risk management factors that are assessed during internal audits.

CHAPTER 9

Internal FRMS Audit

The components that make up a fatigue risk management system will evolve over time as additional information is collected and assessed through normal operations or through investigations into incidents or events. This chapter outlines the kinds of information that can be useful for conducting an internal audit of the company's fatigue risk management system. Sample questions have been provided that make it possible for individuals or groups who are not necessarily fatigue risk experts to perform the audit. While other stakeholders such as regulators may require additional data for their own purposes, the questions provided below can act as a useful starting point.

Ideally, an internal FRMS audit should be conducted one year after the initial implementation, and every two years after that. Internal audits are generally conducted by the safety manager or by an external consultant. However, it is essential that employees be involved in the audit process to obtain their perceptions of how the FRMS is working. After the review, senior management and the FRMS committee should meet to review and discuss the findings and plan any potential changes to the FRMS.

Policy

Used to define fatigue and to outline responsibilities of the employer as well as employees.

- Has a fatigue policy been developed?
- Does the policy clearly detail individual responsibilities of the employer and employee (may also include clients and contractors) in managing fatigue?
- Does the policy specifically help employees, supervisors and managers understand (1) the significance of fatigue management, and (2) their role in keeping levels of fatigue within acceptable levels in the workplace? Has the policy manual been shared with all relevant stakeholders for comment and final approval?
- Has the policy implementation date been chosen or has the policy actually been implemented?
- Has the policy also been applied to contractors who work on-site?

FRMS Committee (or person responsible for the FRMS)

Tasked with the review and guidance of company matters relating to fatigue.

- Has an FRMS committee been established? Or has it been incorporated into a more general safety committee? Or has a person been designated as responsible for the FRMS?
- Does the committee represent all the key stakeholders – for example, operators, supervisors, managers, maintenance and safety personnel, union representatives, as well as trainers?
- Has the FRMS committee (or person responsible for the FRMS) been provided with the resources, information, and technical support to perform its required role?
- Has the FRMS committee (or person responsible for the FRMS) identified major fatigue-related issues, problems, and strengths related to fatigue management in the organization and subsequently developed a fatigue management plan?
- Does this plan deal specifically with training and education, scheduling guidelines, risk management, workforce planning, as well as management training and activities?

Communication and Consultation

To keep all stakeholders informed of the fatigue management process and its progress (may be developed by the FRMS committee or a pre-existing group).

- Have all reasonable methods for communicating to stakeholders been assessed for effectiveness and cost benefit (for example, face-to-face training, e-mail, safety newsletters, posters in the workplace)?
- Have stakeholders been provided with the policy, hours of work guidelines, information about training and education, as well as sources of additional information?
- Have stakeholders been consulted about the implementation of the FRMS? What did the consultation process involve? How did the organization consider each group's point of view in establishing the final FRMS?

Implementation Process

The step-by-step process and schedule for implementation.

- Have supervisors, managers, and those who supervise or manage onsite contractors been trained in the implementation and use of the fatigue management system? Do company management, supervisors, and employee representatives have the skills to implement and manage the FRMS?
- Have all parties received information and procedures for managing fatigue according to the policies and guidelines?
- Have training sessions or workshops been conducted to address any questions and to discuss possible scenarios?
- Has resource material been provided to support these employees after the session?

Schedules and Actual Hours of Work

Where "acceptable" balances safety, operational, and general risk concerns with social requirements.

- Has a scheduling guideline been developed that meets both organizational requirements and fatigue risk management principles?
- Were stakeholders consulted and asked to provide feedback regarding the FRMS scheduling guidelines?
- Were stakeholders provided with adequate information about the specific fatigue implications of various shift structures?
- Has a date been set to implement the scheduling guidelines or have they already been implemented?
- Have specific criteria been developed to manage the effect of overtime, leave and vacation, start and finish times of shifts, and commuting to and from work?
- Has a fatigue assessment tool been used to predict fatigue levels associated with the hours of work? Have the scheduling guidelines been applied to contractors work on site?

Assessment of Actual Sleep Obtained

To ensure that there is a process to be followed if an employee does not feel safe to start or continue work. Ideally, this should be non-punitive.

- Has fatigue been formally recognized as a legitimate reason for employees to stop work and/or request a break?
- Has a system been developed to manage reports of fatigue? What is the system?
- Was the workforce able to participate in the planning and development of the self-disclosure system?
- Has the fatigue self-disclosure system been used? How many reports have been processed over the last week/month/six months/year? (No reports of fatigue over a number of months may indicate that the organizational culture does not yet support the system.)
- Has any employee reported fatigue on so many occasions that it is considered excessive? (It is important that such cases be managed carefully and appropriately and that a clear definition of excessive be in place.)
- Has the FRMS committee or other relevant pre-existing group developed procedures to help supervisors deal with employees who report that they are fatigued?

Development of Training Program

To determine whether appropriate training materials are developed.

- Who is responsible for developing/presenting training materials to employees?
- What are the key components of the training?
- If training materials were developed in-house, was the person or group provided with adequate reference material, financial resources, and support to complete the job to an acceptable standard?

- Have adult learning principles and competency-based training methods been used?
- Were the people who developed the training adequately qualified and/or experienced to develop a fatigue-related program?
- Have the materials been tested and reviewed by groups of employees?

Delivery of Training

To ensure that specific and targeted training occurs using suitably qualified and experienced trainers.

- Are trainers appropriately qualified and experienced? (Experience with shiftwork is a significant advantage)
- Have trainers been involved, or at least fully briefed, in the development of learning outcomes, lesson plans, and other aspects of the training requirements? (For material developed in-house)
- Have trainers been supplied with, or provided access to, reference materials to help answer a wide range of related questions?
- Have trainers been supplied with evaluation forms so that training can be improved?
- Is a training register kept as a record that employees have completed their training?

Incident and Accident Investigation

To update procedures to ensure that fatigue is included as a potential factor to be investigated.

- Has the existing incident and accident investigation process been fully reviewed to determine whether it adequately identifies potential fatigue-related issues?
- Does the process collect data relating to work and non-work related factors that may contribute to fatigue?
- Have incident/accident investigation and training procedures been updated?

Internal Audits

To keep accurate records of implementation for reporting purposes and audits by any outside parties such as regulators.

- Does the internal audit system assess all relevant components of the fatigue management system? (At a minimum, this should include policy, training, hazard control, and audit.)
- Are there additional assessments that might provide valuable information for the organization? If yes, provide details.
- Has a survey or other consultation been conducted within the organization and with any relevant contractors to consider the adequacy of the process and level of impact of the fatigue management system?
- Are follow-up assessments made of training delivery, compliance with scheduling guidelines, implementation schedules, and other parts of the fatigue management implementation?

While the list above suggests that an audit consists of a number of distinct and independent reviews, it should not be forgotten that each component is part of an overall, interactive system.

EXERCISE

- Discuss the benefits of conducting fatigue management internal audits.
- List six aspects of an FRMS that should be assessed during an audit.
- Provide at least three key questions for three of these aspects that should be asked during a thorough internal audit assessment.
- List the departments and/or individuals or groups that need to be involved in the review and update of the incident and accident investigation system as well as the internal audit system.

Resources

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