Road Safety
Research Program

# Fatigue Detection Technology for Fleets Guide

The Australian Automobile Association is the nation's peak motoring body, representing the state-based motoring clubs (the NRMA, RACV, RACQ, RAA, RAC, RACT and the AANT) and their 9.3 million members. It is an apolitical and technology-neutral advocate for federal transport policy that improves safety, affordability, and mobility.

# Contents

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# Executive Summary

## Introduction

Fatigue is a major contributing factor in road crashes in Australia and worldwide.

It is estimated that one in five crashes involve fatigue. One in three Australians report driving while “quite tired” and one in five have driven while so tired they struggled to keep their eyes open.

Causes include insufficient and/or poor-quality sleep, prolonged wakefulness, driving at times when there is a strong biological pressure for sleep (at night and early morning), driving for prolonged periods without a break, and sleep disorders such as sleep apnoea.

All drivers can experience fatigue, but some may be more affected than others. These can include professional drivers; people who have irregular work hours or who drive for extended periods (often exacerbated by monotonous roads and boredom); and people with health issues or social factors (such as newborn children or shift work) that affect their sleep.

Effective management of fatigued driving is multi-faceted. Using fatigue detection technology (FDT) to predict and warn of impending fatigue and related impaired driving is one way to combat fatigued driving.

To help understand how to best integrate FDTs into vehicles and organisations, the AAA Road Safety Research Program commissioned a body of research that:

- Independently assessed different classes or categories of FDTs in a closed track environment and in real-world conditions. Assessments focused on validity, accuracy, impact and usability.
- Developed a way for everyday drivers, professional drivers, and fleet managers to assess and select FDTs that best meet their individual and business needs.
- Worked with drivers, middle managers and company executives who currently use FDTs to identify the key barriers and enablers to acceptance of these systems in the workplace.

The AAA used this research to develop the resources you are now reading.

## What types of FDTs are available?

Workplace health and safety requirements, employee health benefits and corporate social responsibility are driving rapid growth in the market for FDTs.

There are well established systems for predicting and managing fatigue risk in fleets that use shiftworkers to run round-the-clock operations. These use shift schedules and/or previous sleep durations to assess the likelihood of workers being affected by fatigue so that managers can adjust rosters.

These scheduling systems are widely used in the heavy vehicle sector, but they do not suit all organisations.

Moreover, they do not detect actual fatigued driving.

In recent years many new FDTs have become available. These have varying levels of suitability for organisations and drivers. As this emerging sector evolves, more FDT systems are expected to enter the market in coming years.

Currently, two types of FDT are available to help detect and manage fatigued driving.

### Continuous monitoring technologies

These FDTs involve real-time assessment of a driver's physiology or movements while driving. For example:

- Ocular (eye) and head movement
- Heart rate
- Lane deviation

Some systems alert drivers when they reach a pre-determined unsafe drowsiness threshold so they can take appropriate action to reduce their fatigue risk (e.g. taking a break; swapping drivers, if possible; consuming caffeine; or napping). Continuous monitoring technologies are available as native systems (built into vehicle) and after-market systems (available to purchase and install in vehicle).

### Fit-for-duty technologies

Fit-for-duty technologies provide a quick assessment of fatigue-related impairment at a point in time. These technologies are designed to be used at the beginning of each shift or drive to evaluate if the worker/driver can safely proceed, or at random intervals every few months as a general screening tool (akin to a drug/alcohol assessment).

## The research

More than 80 FDTs are commercially available worldwide but there is little validated independent information on these systems' accuracy, efficacy and cost-benefit ratios.

Researchers from Monash University, Central Queensland University and the Institute for Breathing and Sleep examined four categories of FDTs: ocular continuous monitoring, heart rate continuous monitoring, lane keeping/deviation and pre-drive fitness-to-drive devices (eight products were tested across these four categories). This consortium assessed these FDTs' strengths and weaknesses in a range of settings, and compared their effectiveness, useability, and value for money.

The first step of the research was to build evidence to provide clear, independent information on these system's capabilities. Individuals, small businesses, and fleets of various sizes can use the findings to help assess current and future FDTs, select the right FDT for their organisation, and implement and use these devices effectively.

The researchers independently assessed (for validity, accuracy, impact and usability) different types of FDT in a closed track environment and in real-world conditions.

The researchers worked with drivers, middle managers and company executives to develop:

- A framework for individuals and organisations to assess and select which FDTs would work best in their operational contexts
- Change management guidance to optimise FDT implementation in workplaces.

This research delivered two world firsts:

- An independent validation study of a native ocular fatigue detection system
- A naturalistic randomised controlled trial assessing fatigue detection alarms' efficacy in reducing drowsy driving and unsafe driving, and in changing driver behaviour.

## Key findings

No monitoring system detected 100% of fatigue-related incidents, and all monitoring systems had some level of false positive detection (warning of events that are not genuine fatigue events) and false negatives (not detecting a genuine fatigue event).

### What works best

- Continuous ocular (eye-monitoring) fatigue monitoring systems underpinned by validated sleepiness scales are currently the best FDT systems available. They were the most effective at detecting fatigue-related driving impairment and alerting the driver with sufficient time to take corrective action. Their alarms reduce fatigued driving events and hazardous driving events and help change driver behaviour (e.g. scheduling rest stops).
- The tested pre-drive predictive technology (underpinned by validated sleepiness scales) effectively predicted fatigue and the likelihood of fatigue-related driving events by testing drivers before they started driving.
- Effective FDTs make drivers more aware of the need for fatigue management. This can help them self-manage fatigue in other ways, such as by improving sleep hygiene.
- With correct implementation and change management strategies, organisations and individual staff adapted to using an FDT and incorporated it as part of business-as-usual.

### What doesn't work well

- Distraction alarms are ineffective at predicting driving impairment caused by fatigue.
- A tested "native" driver monitoring system installed by a car manufacturer was not sufficiently effective at detecting fatigue-related driving impairment.
- Lane departure warnings are not good at predicting fatigue-related driving impairment.
- Tested heart rate and G-force technologies were ineffective in detecting fatigue-related driving impairment in real-world driving conditions. They rely on drivers keeping both hands on the steering wheel, but drivers frequently change their grip.

The researchers also developed an evaluation framework to assess existing and emerging FDTs. The evaluation framework was developed into a series of questions for organisations to consider when investigating FDTs. The research team also identified several enablers and barriers to implementing FDT for a range of end-users, which have been included in this document.

## Selecting and implementing driver FDTs

There are several reasons for considering buying and implementing FDT, and fleet operators may need to gain support from key personnel and decision makers. Chapter 1 outlines the reasons for considering FDTs and offers advice on how to gain support within an organisation.

The research has been used to develop a decision-making guide to help potential users assess several factors in the context of their own requirements. This can enable individual consumers, small businesses, and fleets of all sizes to make informed decisions when selecting FDTs. This guide is contained in Chapter 2.

Effective implementation and roll-out is also critical.

There is no "one-size-fits-all" type of FDT that suits all drivers and all businesses. Organisations must decide what would work best for them.

The "most effective" FDT may be too expensive or incapable of being integrated into the business for a range of possible reasons, such as vendor support requirements or administrative workload.

This research used qualitative approaches to identify key barriers to effective implementation, as well as enablers that can optimise FDT adoption. This information is in Chapter 3.


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CHAPTER 1

# Building organisational support for FDT

Implementing FDT can be a large investment, so gaining support and engagement from the organisation's executives is important for success.

Gaining organisational support and selecting the right FDT system for your fleet are tasks that overlap considerably. Typically, a manager must win support for the concept of introducing an FDT device; then a preferred system must be identified; and then the proposed implementation of that preferred system must be justified to staff across the organisation.

It is strongly recommended that a "project or business sponsor" is identified to undertake this work at the onset of the project. This role would have overall responsibility and provide guidance, and it would link the organisation's key stakeholders. This may be either a fleet representative or a representative from another part of the business, such as workplace health and safety.

## Define the problem

Without a method to detect fatigue incidents, organisations may be unaware of the extent of their fleets' fatigue problems. Compliance with regulatory obligations may not be enough to ensure all fatigue risks are being properly managed.

Building a case to introduce FDT requires evidence or data. This can be collected by:

- Reviewing the organisation's historical driving incidents to determine whether fatigue has been reported previously (include actual crashes, serious incidents and near misses).
- Using telematics data if available for your fleet (to reveal harsh braking or cornering, and speed inconsistencies).
- Analysing workforce demographics to identify any risk patterns that could increase likelihood of fatigued driving incidents, such as age, years of driving experience and health status.
- Analysing the fleet's driving patterns (e.g. shift times, the time of day when driving, and the type of driving – long/short/metro/rural).
- Undertaking anonymous surveys of fleet drivers regarding sleep patterns, driving experience, previous fatigue incidents.

Consider also using other industry contacts and networks to identify a case study of successful FDT implementation.

## Show the benefits of FDT implementation

Outlining how FDT can benefit the organisation is a critical way to generate support for the implementation process and show the technology can offer a return on investment (ROI). This can be challenging without data or defined measurements to clearly show the ROI. But there are other benefits that can align with an organisation's strategic direction, safety culture or environmental, social and governance principles.

- Improved safety and health for drivers, including fewer fatigue-driving related incidents; better health outcomes as drivers and managers pay more attention to fatigue, rest and sleep; and compliance with duty of care and WHS obligations.
- Increased staff retention due to a supportive and safe work environment.
- Better driver awareness and possible changes in driving behaviour related to fatigue management.
- Increased training and development opportunities.
- Fewer vehicle crashes/incidents and less damage to the company fleet.
- Benefits to the wider community through safer driving in communities.
- Brand protection and enhancement through fewer fatigue-driving incidents and improved safety culture.
- Fewer insurance claims and lower associated costs.
- Reduced complaints against drivers and protection against false or malicious claims related to driving incidents (depending on the system, video recording in company vehicles may provide evidence for the driver in the event of an incident).

## Identify a solution

Offering potential solutions can increase organisational engagement.

This should include a thorough evaluation process to show that consideration has been given to the best solution for your organisation. Please see Chapter 2 on "Selecting the right FDT for your organisation".

When presenting the outcomes of the work undertaken to choose the right FDT for your organisation:

- Show that alternatives and other viable options have been considered.
- Provide detailed information on why the chosen FDT is the best one for your organisation (this can include effectiveness, reliability, fit for fleet, cost etc).
- Highlight the benefits of implementing this FDT – consider using an industry case study to show the improvements achieved through its use of real-life impacts.
- Show evidence that the chosen FDT equipment and mountings (and the optimal location within the vehicle) comply with all road laws in the jurisdiction where the equipment will be operating. This information can be obtained through the vendor, but your organisation should confirm this with your local road authority as the vendor's advice may not cover all aspects of compliance.
- Consider and address any risks associated with using the FDT in your business.
- Provide evidence of key stakeholder engagement, including with fleet managers, supervisors and drivers, human resources business partners, WHS representatives, staff associations and unions.

## Demonstrate success through a small pilot

Piloting proposed FDT solutions is one of the best ways to secure organisational buy-in. Choose an area of the business where you have strong executive and employee support and have a flexible and adept user base and ensure the pilot project is representative of the type of fleet vehicles that will use the FDT.

It is also important to pilot your solution for a long enough time to see the FDT in action across most "business-as-usual" scenarios for your organisation before rolling it out widely. This could be as little as several weeks for a smaller fleet through to several months for a more complex organisation.

The pilot can be used to also collect data to assess the workload, resources and skills required for ongoing administration of the system and to manage and report on FDT alerts as a part of business-as-usual processes.

A pilot also lets the organisation seek appropriate legal advice about any issues that may arise in FDT implementation, particularly regarding occupational health and safety laws. It also provides opportunity to develop policies and principles covering the use of FDT within the organisation before a wide-ranging deployment. Questions to consider in developing policies for your organisation may include:

- Will the FDT equipment always be activated in the fleet vehicles or only during business hours? Will audio be recorded?
- How will the FDT equipment differentiate between working and non-working hours – will drivers be required to turn the FDT on and off?
- If the fleet vehicles are used for private use, what are the implications for passengers in terms of recording of data?
- If fleet vehicles are to be used for part-private use, can the passengers be "seen" in the FDT camera's field of vision? If so, what are the implications for privacy and data protection?

A successful FDT pilot can also help generate excitement and engagement through the wider organisation about the implementation's benefits for staff safety and wellbeing.

A small pilot will also demonstrate to the executives/ senior management that any implementation risk factors have been fully considered before a large-scale financial commitment.

## Build support

Organisational support is critical for FDT implementation, particularly the support of executives and decision-makers.

To build support you must show that the differing needs and motivations of all parts of the organisation have been considered. This can be achieved by:

- Scheduling one-on-one conversations with senior management/executives to get a feel for their support for the idea and address any scepticism or reluctance they may have about the FDT.
- Seeking feedback from other areas of the business – fleet managers, drivers, human resources, staff associations, unions, and WHS managers – through information sessions, workshops or one-on-one discussions.
- Using a survey to gain information on the level of support for FDT implementation and potential resistance or opposition.

CHAPTER 2

# Selecting the right FDT for your organisation.

Organisations considering using FDT should carefully consider their needs, budget and how available systems might best integrate with their broader approaches for managing fatigued driving.

This chapter explains the types of FDTs available and provides a guide to help decision makers understand the pros and cons of each type.

This stage and the previous chapter's stage – Building Organisational Support – overlap considerably. Typically, a manager must win support for the concept of introducing an FDT device; then a preferred system must be identified; and then the proposed implementation of that preferred system must be justified to staff across the organisation.

## Range of FDTs

### Continuous monitoring technologies

These technologies provide real-time feedback about a driver's physiology or behaviour while driving by assessing factors such as eye and head movement, heart rate or a driver's ability to stay within a road lane. Some systems alert drivers when they reach a pre-determined unsafe drowsiness threshold so that they can take appropriate action to reduce their fatigue risk (e.g. take a break; swap drivers, if possible; consume caffeine; or have a nap). Continuous monitoring technologies are available as both native (built into a vehicle) and after-market systems (available for purchase and installation).

### Fit-for-duty technologies

Fit-for-duty technologies provide a quick assessment of fatigue-related impairment at a point in time. These technologies are designed to be used at the beginning of each shift or drive to evaluate whether the worker/driver can safely proceed, or at random intervals every few months as a general screening tool (akin to a drug/alcohol assessment).

## Assessing which FDT will work for your organisation

Currently more than 80 types of FDTs, native and after-market, are available worldwide.

Not all FDTs perform equally well. Because many details about algorithms and thresholds used to trigger alarms are proprietary and not in the public domain, comparison can be difficult. Costs of aftermarket devices are also not always readily available, and it is difficult for consumers and organisations to know whether devices and the approaches they take to fatigue detection have been independently validated.

In addition, there is no one-size-fits-all FDT or product that suits all businesses. Indeed, the research showed the most effective products may be out of reach for smaller businesses because of cost or other factors such as inability to integrate them into existing operational systems.

To make the right call, decision makers must consider the efficacy of a particular device, its features, and its potential impact on drivers and the organisation overall. This chapter examines each of these factors and includes assessment templates to help fleet managers assess what would best suit their needs.

Each assessment category and its dimensions are explained in detail in the section below. It is recommended that the first category – device efficacy – is assessed first. Assessment of the remaining categories could occur concurrently.

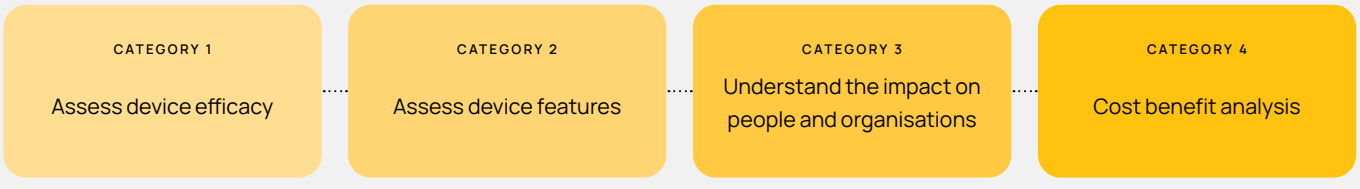
Assessment priorities will differ from one business to another, based on factors like risk appetite, budget, safety culture, existing fatigue-management policies, fleet size, where the fleet operates, and whether there are different types of vehicles in the fleet. Therefore, there is no threshold rating for each category to ascertain a pass or fail. The use of scoring in each of the categories is intended to help the user assess a potential FDT against those priority areas that are most relevant to their organisation and its decision-making process.

The following assessment template recognises this and uses a five-point scale that allows organisations to consider devices within the context of their own structures and operations.

The five options are:

1. Very dissatisfied
2. Dissatisfied
3. Neither dissatisfied nor satisfied
4. Satisfied
5. Very satisfied

### Steps toward implementing FDT



## Assessment Category 1 - Device Efficacy

### Quality of validation studies

Without validation studies that examine an FDTs performance, it is difficult to make informed decisions about efficacy. A lack of validation data may raise concerns about the reliability and validity of the FDT, which would result in a low rating.

To rate highly in this category, a product would have independent, peer-reviewed validation with publicly available data sets that include metrics for validation. Such studies would ideally be conducted by researchers who have assessed the FDT's performance in real-world scenarios using appropriate processes to manage any influence of bias. These studies would also demonstrate the use of appropriate measures and/or metrics for validation.

Although vendor validation may offer some insights into the FDT's performance, it may lack transparency and could be seen as being biased.

### False negatives

To rate highly in this category, an FDT must have a low incidence of false negatives – or failure to detect genuine instances of fatigue. Failure to accurately identify fatigue in users may increase the likelihood of driving errors, near misses, and vehicle crashes.

### False positives

False positives occur when the FDT mistakenly detects fatigue in a person who is not fatigued. A high rate of false positive alarms leads to unnecessary alerts and interruptions, causing frustration and inconvenience for the user. False alarms also undermine confidence in the product and could incentivise drivers to ignore or disable alerts. False positives may also unnecessarily increase workloads for supervisors/data-users who manage fatigue alerts within an organisation.

### Detection latency

This refers to the FDT's ability to detect early-stage fatigue that could cause a potential fatigue-related error, near-miss, or crash. FDTs that can detect fatigue significantly earlier and predict the likelihood of fatigue-related driving error occurring rate more highly in this category as they give drivers time to pull over to prevent a fatigue-related event occurring. Devices designed to use validated physiological measures – such as eye movement – to predict likely future impairment may rate more favourably in detection latency.

### Reliability

Reliability refers to the FDT's capacity to produce similar results when deployed in various vehicles, accounting for differences in cabin conditions, vehicle types, and driving environments (such as hot and dusty conditions with high levels of vibration). To rate highly, FDTs must also be reliable across geographic locations, functioning effectively in different climates, when telecommunications network coverage is limited, and in response to any other location-specific factors.

### Notification time for FDT failure

Notification time for FDT failure refers to how quickly an organisation and/or user becomes aware when the FDT is not working. Examples of failures would be a broken camera, loose wires, or lack of power. To rate highly in this category, there would be a short duration between a failure occurring and the organisation and/or user being notified. This also ensures that any issues, tampering, or malfunctions are promptly detected and addressed, minimising the potential risks associated with unreliable fatigue detection.

Low-scoring FDTs may have a prolonged failure notification time. This delay could undermine a device's reliability, potentially leading to missed instances of fatigue, and compromising safety.

Five-point rating scale

1 VERY DISSATISFIED 2 DISSATISFIED 3 NEITHER DISSATISFIED NOR SATISFIED 4 SATISFIED 5 VERY SATISFIED

| ASSESSMENT CATEGORY 1 - DEVICE EFFICACY | | | |
|---|---|---|---|
| DIMENSION | KEY CONSIDERATIONS AND QUESTIONS | ASSESSMENT | RATING |
| **Quality of validation studies** | Has the device been independently validated, and can the vendor point to the validation studies?<br><br>If not, does it measure a valid fatigue indicator (e.g. eye closure)? | How satisfied are you about the product's validity and vendor's transparency?<br><br>To rate highly:<br><br>• Vendors can show evaluation studies that are independent, peer reviewed and published.<br><br>• The vendor will provide the algorithms, fatigue indicators and thresholds, and discuss them so you can make informed decisions.<br><br>• The vendor can provide evidence the device is based on a valid fatigue indicator. | |
| **False negatives** | How often does the device fail to detect real fatigue? | How satisfied are you with the fatigue detection thresholds built into the product?<br><br>To rate highly:<br><br>• Devices have demonstrably low false negative rates.<br><br>• Rates are comparable with market leaders (where less than 20% of real fatigue events do not generate alarms). | |
| **False positives** | How frequently are alarms triggered when drivers are not experiencing real fatigue? | How satisfied are you about the fatigue detection thresholds built into the product?<br><br>To rate highly:<br><br>• Devices have demonstrably low false positive rates.<br><br>• Rates are comparable with market leaders (where 60%-90% of alarms are genuine fatigue events). | |
| **Detection latency** | Earlier detection gives more time to take preventative measures.<br><br>Does the device detect early-stage fatigue? (consider this in terms of actual time – 1 minute, 2 minutes etc).<br><br>Does the device enhance drivers' use of fatigue countermeasures to reduce drowsiness and crash risk? | How satisfied are you that the device can detect early-stage fatigue?<br><br>To rate highly:<br><br>• the device can detect fatigue before the drive starts and/or<br><br>• the device can act as an early warning signal enabling the driver to act before it is too late.<br><br>• the vendor can advise you of the detection times. | |

| ASSESSMENT CATEGORY 1 - DEVICE EFFICACY (CONT.) | | | |
|---|---|---|---|
| DIMENSION | KEY CONSIDERATIONS AND QUESTIONS | ASSESSMENT | RATING |
| **Reliability** | Does the device work consistently across a variety of circumstances, environments and locations?<br><br>Are there specific requirements for optimal functioning, such as Wi-Fi connectivity or specific road environments?<br><br>Will the device be effective in a variety of conditions (such as hot and dusty or roads that cause a lot of vibrations).<br><br>Does the device continue to function if connection to the internet is lost?<br><br>Does the device require constant tactile engagement by the driver (i.e. hands on the wheel)?<br><br>Does the device require clear input from road infrastructure (such as lane markings)? | How satisfied are you that the device can operate effectively for your staff's tasks and in the areas where they drive?<br><br>To rate highly:<br><br>• the vendor must clearly and transparently provide the requirements for the device to operate at its optimum rate. | |
| **Notification time for FDT failure** | If the device stops working effectively, will it inform the driver and/or management team? | How satisfied are you that drivers and/or the organisation will know quickly about any malfunction?<br><br>To rate highly, the device:<br><br>• confirm to the driver when the system is on and working<br><br>• has thresholds to detect a malfunction<br><br>• records the malfunction<br><br>• provides timely notification to drivers and/or managers<br><br>• makes it easy for drivers to detect a malfunction. | |

## Assessment Category 2 - Device Features

This category relates to FDT features that should be considered based on organisational needs.

### Availability

To rate highly on availability, a diverse range of organisations and users must find the FDT easy to obtain. High-scoring FDTs would ideally be available not only to large organisations, but to small and medium-sized organisations and potentially at the individual level. This dimension may also be important for multi-national companies that wish to introduce consistent FDT across countries and jurisdictions.

### Compatibility

Compatibility refers to how the FDT will interact and integrate with existing technology in the vehicle or new/upgraded technology introduced to the device (e.g. a new software update). To rate highly on compatibility, an FDT would have both forward and backward compatibility. For example, if older iterations of a FDT stop functioning when new software is released, that FDT would score poorly.

FDTs that have installation challenges associated with vehicle integration and retrofitting may get lower ratings. An FDT that is in-built in the vehicle (native system) may be considered highly compatible because it is already part of the vehicle. But some systems, including native systems, may also face challenges due to changes in third-party technology such as the phase-out of 3G telecommunications.

A device's configurability of the device across different vehicles (e.g. cars, vans and trucks) must also be considered. To rate highly the FDT would require minimal adjustments across the fleet.

### Data visibility

Scores in this category will vary according to an organisation's requirements.

The FDT must provide data directly to the driver (through an alert/alarm or pass/fail).

To achieve a higher rating on data visibility, an FDT's data would be available to a range of the organisation's relevant stakeholders. While an individual motorist might demand full control of their own data, company fleet operators require data for trend analysis, oversight, organisation-level fatigue management strategies, maintenance or vendor troubleshooting.

The highest level of data visibility would involve the driver, organisation, vendor, and regulator having access to the data. This level of access might be required for regulatory compliance or oversight.

All data handling practices must comply with relevant privacy laws and regulations to protect the driver's anonymity. Some organisations may prefer FDT that is in the mid-range – data visible only to the driver and within the organisation – to avoid formal regulatory oversight.

### Data security

Data security is critical in protecting sensitive personal information from being accessed, manipulated, or hacked by unauthorised individuals. To rate highly in this category, an FDT's data would need to be collected, transmitted, and stored in a highly secure manner. High-scoring FDTs would have strong data security systems, including appropriate data encryption, secure servers, and networks designed to minimise the likelihood of unauthorised access or data breaches.

FDT's that rate highly would also comply with or exceed relevant data protection regulations and/or external data security frameworks. FDTs that have a large 'data footprint' (i.e. multiple streams of data stored in different locations with more risk of data security problems) may rate poorly. Data that is more identifiable (e.g. video footage) may require higher levels of data security and may affect rating, depending on the organisation's existing data security protocols.

### Intrusiveness

Intrusiveness relates to the likelihood of driver resistance towards the FDT due to actual or perceived intrusion into their work environment. This dimension assesses the extent to which the FDT encroaches upon the driver's workspace though factors like obstructing the driver's field of vision, impeding their work tasks, or necessitating additional wearable equipment on their face or body, beyond their typical attire and accessories. But wearables that seamlessly replace existing attire and accessories could be considered acceptable within this dimension.

FDTs that remain inconspicuous and unobtrusive until activation are likely to receive higher scores on this dimension. To receive a favourable rating on the intrusiveness dimension, there should be minimal impact on the driver's workspace and daily routine.

Five-point rating scale

1 VERY DISSATISFIED 2 DISSATISFIED 3 NEITHER DISSATISFIED NOR SATISFIED 4 SATISFIED 5 VERY SATISFIED

| ASSESSMENT CATEGORY 2 - DEVICE FEATURES | | | |
|---|---|---|---|
| DIMENSION | KEY CONSIDERATIONS AND QUESTIONS | ASSESSMENT | RATING |
| **Availability** | Is the device readily available for purchase or implementation?<br><br>What are the timeframes for delivery of the product – is this impacted by the volume to be purchased? | How satisfied are you that the device is available for purchase, installation and implementation?<br><br>To rate highly:<br><br>• The device is readily available.<br><br>• Any lead time from purchase to delivery is acceptable based on your circumstances. | |
| **Compatability** | Can the device be easily installed into the vehicle and easily used?<br><br>Is the device compatible across a variety of vehicles (if the fleet has different types of vehicles or models)?<br><br>Does installation require modifications that may impact resale value for fleet vehicles?<br><br>Can it be customised for different drivers' needs and characteristics (e.g. height and facial structure, spectacles/sunglasses)<br><br>Is it compatible with 4G and/or 5G networks?<br><br>Is additional hardware needed? | How satisfied are you that the device is compatible with the vehicle or vehicles that it will be fitted to?<br><br>To rate highly:<br><br>• The device is built into the vehicle at time of purchase.<br><br>• Any additional requirement/s for software or other technology is clear (and within acceptable limits).<br><br>• Training will be provided by the vendor.<br><br>• The device fits within the vehicle/s and does not obstruct vision or lead to other issues.<br><br>• Assistance will be provided to install the device. | |
| **Intrusiveness and discomfort** | Would drivers find the device to be significantly intrusive?<br><br>Will it impede driver comfort, vision or ability to undertake the work tasks?<br><br>Does any element – such as infrared light – pose a health risk?<br><br>What are driver acceptance rates in end-user fleets? | How satisfied are you that the device will not be overly intrusive or cause discomfort to drivers.<br><br>To rate highly:<br><br>• The device will not obscure vision.<br><br>• The alarms (sound or vibration) will not cause an unacceptable level of discomfort to drivers. | |

| ASSESSMENT CATEGORY 2 - DEVICE FEATURES (CONT.) | | | |
|---|---|---|---|
| DIMENSION | KEY CONSIDERATIONS AND QUESTIONS | ASSESSMENT | RATING |
| **Data visibility** | High levels of data visibility enable organisation-level fatigue management, as well as maintenance and troubleshooting.<br><br>Is the data available to drivers, managers and the vendor?<br><br>Who receives the alarms? Is there a monitoring system for management oversight and reporting? | How satisfied are you that the device and its integration with workflow will provide the level of assurance that fatigue incidents are detected and being managed.<br><br>To rate highly:<br><br>• Drivers are alerted to a potential fatigue alert in real time.<br><br>• There are systems for management to access data to make informed decisions about how to best integrate the device as part of a fatigue management strategy.<br><br>• There will be multi-layers of alerts: the driver, the vendor to validate and to management if a genuine fatigue event is identified. | |
| **Data security** | How is the data stored securely? Who has access to it?<br><br>What happens to any stored data on your servers?<br><br>Is the device compatible with your privacy policy? | How satisfied are you about the level of data security needed and how that will be managed.<br><br>To rate highly:<br><br>• The vendor would provide clear guidance about where data will be stored and what security protocols, back-ups and redundancy are available to support the device.<br><br>• Internal procedures can be adjusted to ensure adherence to privacy laws and policy. | |

## Assessment Category 3 - Impact on People and Organisations

This represents the overall impact the implementation and ongoing use of an FDT will have upon an organisation. Not all end-users will have the same requirements.

### Additional driver workload

To what extent does the FDT divert a driver's focus away from their primary tasks and activities (particularly driving itself)? FDT that carries little or no additional driver workload rates well in this respect, while FDT requiring increased interaction from the driver (such as calibration and adjustment) in a way that unreasonably impedes safety or productivity would rate poorly.

### Administrative workload

Introducing FDT will entail some additional bureaucracy, resourcing and administrative requirements.
The question is - how much is reasonable?

FDTs that do not require significant additional resourcing, such as a need for dedicated technical/management staff, may rate highly on this dimension.

FDTs that require substantial adjustments to ways of working (e.g. lengthy processes to address fatigue notifications or 'on-call' rosters for administrative staff) may rate poorly.

FDTs with clear presentation of data (e.g. dashboards) that are easy to interpret, export and use may rate highly on this dimension.

### Training load

FDTs that may rate poorly on this dimension include those that: require a long time to train staff and demand high levels of technical literacy; introduce additional layers of training (including ad-hoc one-to-one training to address individual issues); and that require a significant accumulation of experience to be used effectively.

However, some organisations may be willing to accept a higher training load if the FDT rates more favourably in other dimensions.

### Vendor support

This refers to the level and quality of assistance and customer service that an FDT manufacturer/supplier provides. This would apply to both in-built (native) and after-market FDTs. To rate highly on this dimension, the vendor would be easy to contact and responsive, at both this initial procurement and ongoing repair/maintenance stages and would also have a clear and effective mechanism for leaving objective feedback about their service and for escalating issues where needed. Manufacturers/suppliers who do not resolve queries quickly or efficiently will rate poorly on this dimension.

Five-point rating scale

1 VERY DISSATISFIED 2 DISSATISFIED 3 NEITHER DISSATISFIED NOR SATISFIED 4 SATISFIED 5 VERY SATISFIED

| ASSESSMENT CATEGORY 3 - IMPACT | | | |
|---|---|---|---|
| DIMENSION | KEY CONSIDERATIONS AND QUESTIONS | ASSESSMENT | RATING |
| **Training load** | What training will drivers and management need to use the device and to interpret and respond to alarms?<br><br>Are there known organisational barriers to implementation? | How satisfied are you that the training to effectively use the device is manageable for the organisation?<br><br>To rate highly:<br><br>• The time and associated costs to train drivers and management are not excessive for the organisation.<br><br>• The vendor will provide adequate support and training on how to use the device effectively<br><br>• the vendor can offer training support. (Users should ensure any additional fees are identified and considered as part of the cost-benefit analysis.) | |
| **Driver workload** | To what extent will the FDT divert drivers from their primary tasks (especially driving)?<br><br>Are there fitting, adjustment and calibration requirements? | How satisfied are you that the organisation can manage the impact on drivers is manageable and that the device will not unduly divert drivers from their primary tasks (especially driving)?<br><br>To rate highly:<br><br>• The impact on drivers will be clear and minimal<br><br>• requirements to fit/adjust/calibrate the device (if relevant for the FDT type) are clear.<br><br>• Vendor support for fitting/adjustment/calibration is sufficient for the organisation. | |
| **Administrative workload** | What organisational resource allocation is needed beyond receiving and responding to alerts?<br><br>Must the organisation identify a single FDT manager, or will responsibility reside in a team?<br><br>Does the device require your organisation to monitor and respond to the alarms/videos/ information captured?<br><br>Does the device require ongoing support from your organisation (re-calibration, training) | How satisfied are you that the administrative workload is understood and is manageable for the organisation?<br><br>To rate highly:<br><br>• The end-to-end impact is clear and manageable.<br><br>• The organisation has sufficient resources to handle the administrative workload. | |

| ASSESSMENT CATEGORY 3 - IMPACT (CONT.) | | | |
|---|---|---|---|
| DIMENSION | KEY CONSIDERATIONS AND QUESTIONS | ASSESSMENT | RATING |
| **Vendor support** | Does the vendor offer ongoing support for implementation and utilisation?<br><br>Is the vendor based overseas? If so, how will it offer timely support?<br><br>What is the lead time for equipment from the vendor – does it change depending on the volume required?<br><br>What level of support does the vendor provide, and does it meet the organisation's needs?<br><br>Can the vendor provide training for staff within the organisation to support implementation?<br><br>Are there additional costs for the vendor support?<br><br>Is 24/7 support available? Is this necessary?<br><br>Do you require an additional contract for vendor support arrangements? | How satisfied are you with the level of vendor support being offered?<br><br>To rate highly:<br><br>• Vendor support for fitting, calibration, monitoring and troubleshooting is clear and costs are transparent.<br><br>• Costs are manageable for the organisation. | |

## Assessment Category 4 - Cost Benefit Analysis

The final step is to undertake a cost benefit analysis assessing the return on investment, including its broader value within the organisation.

### Cost-benefit

To rate highly, the FDT must demonstrate a high return on investment in terms of monetary value, risk reduction, or both.

Costs may include initial purchase of equipment, installation, resourcing (both vendor and organisational), ongoing payment (such as subscription models, equipment support or vendor monitoring of alerts), increased data costs (storage or telecommunication costs for alert messages), training, and replacement costs (such as unit replacement frequency to address technology obsolescence/change or wear and tear).

Benefits may include both cost savings (including avoiding the financial costs, reputational impacts, and/or operational flow-on effects) and safety enhancement.

If the FDT rates highly on other key dimensions but has a high associated cost, it may still rate highly on a cost-benefit dimension.

**Five-point rating scale**

1 VERY DISSATISFIED 2 DISSATISFIED 3 NEITHER DISSATISFIED NOR SATISFIED 4 SATISFIED 5 VERY SATISFIED

| ASSESSMENT CATEGORY 4 – COST BENEFIT ANALYSIS | | | |
|---|---|---|---|
| DIMENSION | KEY CONSIDERATIONS AND QUESTIONS | ASSESSMENT | RATING |
| **Cost-benefit** | How much does the device cost?<br><br>Does its efficacy and expected benefits justify the cost? | How satisfied are you that the potential benefits from the device justify its cost?<br><br>To rate highly:<br><br>• The product should rate highly in all three dimensions of this assessment.<br><br>• The costs (both up-front and ongoing) are clearly identified, and any potentially hidden costs have been identified and quantified. | |

CHAPTER 3

# How to implement FDT in your workplace

Once an organisation has identified a preferred FDT, the next issue to consider is its implementation. This chapter provides practical guidance on issues to consider during implementation, including barriers and enablers to that process.

Because FDTs are interactive, organisations must consider how their system will interface with staff, existing tasks, and administrative processes.

A good roll-out will ensure the FDT is well integrated into the organisation's systems, routines, policies and procedures, which will optimise acceptance by drivers and administrators.

Well-executed implementation not only enables the FDT to function optimally, but also sets up a framework for effective ongoing monitoring, improvement and adaptation.

For some organisations, trials or a phased-in implementation may be the right approach.

To implement FDT effectively, it should be integrated within the organisation's existing safety management system. Organisations should also develop policies and procedures to ensure relevant staff understand how the FDT works, as well as their roles and responsibilities regarding FDT.

This approach should include clear training and induction processes, so workers understand how to use the FDT, what to do when an alert is triggered, and what to expect once the FDT is rolled out.

During implementation, avoiding using punishment (e.g. a written warning) as a response to fatigue alerts would enhance users' acceptance of the FDT. Successful implementation strategies focus on supporting learning and behavioural changes and identifying "hot spots" for fatigue risk that might require additional control measures.

Clear communication from leaders in the organisation, including information on the selected FDT's functionality, is a strong enabler of implementation. Conversely, poor communication can lead to misunderstandings being spread among drivers, which can foster hostility to the FDT.

Good communication enhances drivers' understanding of the FDT, gives them a sense of ownership, and addresses concerns they may have about privacy and data security.

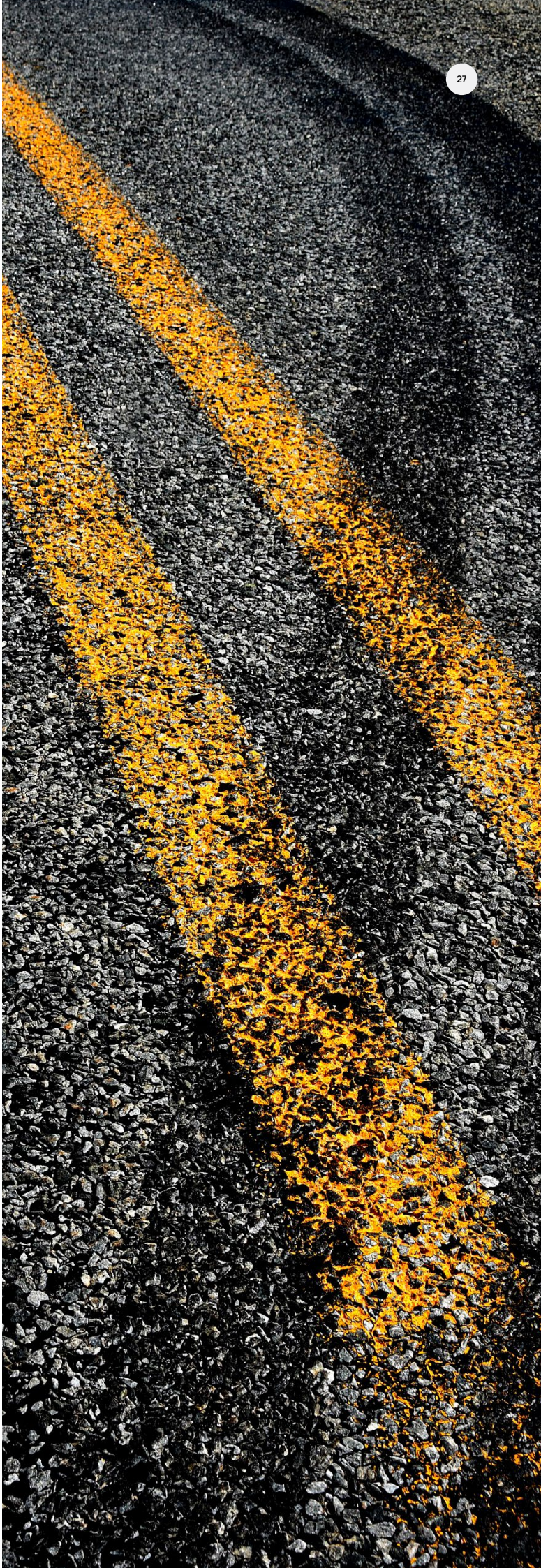
Driver support was optimised when drivers were provided with:

- An extended consultation period.
- Standalone training or inductions.
- Clear guidance on how to use the FDT.
- Clear information on the FDT's limitations (particularly concerning use of the data).
- Information on how in-vehicle camera technologies can improve safety, and assurance that they are not intended as a form of surveillance.

It is recommended that providers and/or employers provide a comprehensive explanation of alarm systems for end-users to ensure they fully comprehend the functionality. For example, failing to make any distinction between an FDT system's fatigue and distraction alarms clear to drivers could lead to a misunderstanding of that FDT's capabilities and limitations.

In many cases, the most effective and compelling form of communication was reported to be use of in-vehicle camera video footage – for example, footage of a driver falling asleep and being awakened by a FDT alarm.

The research also found most FDT end-users adapted to the new system. FDT use generally has a positive impact on driver behaviour and becomes business-as-usual.



## What factors are barriers to user acceptance of FDT?

Six core barriers to driver acceptance and organisational implementation of FDT should be considered when planning to integrate a FDT into your organisation 's "business-as-usual" practices.

### Negative experiences

- Additional workload for drivers who are required to monitor the FDT and for managers dealing with alarms and feedback loops.
- Administrative burden, including with potential legal implications.
- False positives – activation of alarms for non-fatigue events can cause annoyance, pressure and stress for the drivers, particularly if the system has a high number of false positives.
- User impact – drivers can be annoyed by fatigue detection alerts and alarms, including FDTs that use vibrating seats.
- Annoying late-night calls to managers based on false alarms.

### Limitations of the chosen FDT

- Too many false positives – lane checks and other tasks require drivers to take their eyes off the road immediately ahead, which can trigger false positives.
- Lack of integration – mounting an FDT system in the vehicle can be difficult and lead to devices detaching and becoming inoperative; some mounted devices also have the potential to obstruct drivers' views.
- Malfunctions – an FDT may fail to operate as designed, for example video might not record due to technical issue or the FDT might activate in a stationary position with the parking brake on.
- Ill-fitting FDTs – some systems can be difficult to fit to some drivers because of their individual face shape, eye shape, height or other characteristics.

### Misinformation and poor communication

- Fears about data use – some drivers worry their employer is collecting data to judge performance; others have concerns data might be used for legal purposes such as police investigations.
- Privacy and surveillance – some drivers see the FDT as invading their privacy.

### Health concerns

- Infrared (IR) sensors aimed at the eyes can unsettle some users concerned about possible eye damage from IR light.
- Seat vibrations – the forceful vibration of some seat alarms could aggravate existing back or joint injuries.

### Diminished learning opportunities

- The FDT can be used to punish drivers instead of educating them.
- Having office staff with less real-world driving experience than professional drivers reviewing footage related to alert can lead to resentment.
- There is a risk that the FDT does not teach fatigue management or improve driver behaviour, but instead teaches drivers how to avoid alerts.

### Poor vendor support

- Slow reaction from vendors to inquiries seeking technical support.
- Overseas offices – using vendors primarily based overseas can be challenging for getting technical support during work hours due to time zone differences.
- Internet connection issues for the device, particularly in rural and remote locations, may delay access to vendor support.
- Low cost-benefit – if the FDT is expensive, the level of service received may not offer value for money.
- Life-expectancy of the FDT – the technology might be superseded or become incompatible with vehicles or other systems over time.

## What factors enhance employee acceptance of FDT?

There are seven enablers that can foster driver acceptance and organisational implementation of FDTs.

### Reassurance

- Feeling safer.
- Helping drivers manage work pressures, including by discouraging poor driving practices such as failing to take a break.
- Personal back-up – drivers can rely on the FDT to back them up while driving.
- Family comfort – drivers' families know they are being supported to drive safely.
- Having vendors provide clear information, based on scientific evidence, on the health implications of FDT use, including the intensity of infrared light used in their devices.

### Effectiveness

- Effective FDTs foster improvements in driving behaviour.
- Reduced risk-taking and increased willingness to manage fatigue.
- Satisfaction with device reliability – seeing an FDT's consistent ability to detect fatigue, wake the driver up, and prevent a fatigue related crash is a critical enabler.

### Continuous improvement

- Refinements to devices and software create ongoing improvement.

### User-friendly

- FDTs that are easy to adjust or reposition reduce false positives and enhance driver experience.
- A hassle-free installation, which can include good vendor support and guidance, enables a smooth rollout.
- Ideally, FDTs require no driver interaction – they are already fitted to the vehicles and turn on automatically when the vehicles start.
- Technical support should be responsive and effective.

### Learning tool

- FDT devices can help drivers adapt between short and long-distance drives and better understand their limits when driving long distances.
- The FDT can help drivers understand the importance of managing their own fatigue and to learn effective ways to do this.

### Identifying health concerns

- FDT can help detect underlying health problems for workplace drivers.
- Discussions with drivers who have experienced multiple micro-sleeps or fatigue events can prompt them to seek medical advice around any potential undiagnosed health issues (such as sleep apnoea).

### Incidental benefits

- FDT can identify the prevalence of fatigue incidents that were previously unidentified as there was no means to detect them.
- Reduced driver distraction.
- Drivers become more aware of their driving behaviours and the FDT contributes to eliminating non-compliant behaviour.
- Reduced vehicle crashes and insurance costs.
- Enhanced visibility of business operations for managers.
- Recorded footage of the road ahead can be used to defend against allegations of traffic rule violations or public complaints.

## Implementing FDT into your organisation

Taking a structured approach to implementing a change in an organisation will improve the chances that FDT is accepted into business-as-usual practices.

These barriers and enablers can be considered in the context of your organisation's current change management processes. If your organisation does not have defined change management processes in place, the following steps can be used to help guide the implementation.

### Define the objectives

Setting clear objectives for introducing FDT will help develop a clear focus and transparency to assist successful implementation. This step should include:

- Identifying specific issues and challenges that FDT must address – for example "decreasing fatigue-related driving incidents within the fleet".
- Considering whether the FDT solution can tackle any other issues for the organisation, such as seatbelt use.
- Engagement with key stakeholders – this will include executives, managers and supervisors, staff associations and unions, and of course the drivers. This will enable collation of diverse perspectives on implementing FDT into the organisation and help with planning for a smooth transition.

Objectives can also be refined during the implementation phase.

### Identify the proposed solution

This stage will happen prior to implementation – see Chapter 2

### Pilot testing

It is strongly recommended to undertake a pilot test/phase before making a wider commitment to a specific FDT product. To evaluate the FDT in your organisation have a small set of drivers use it as a part of a business-as-usual routine for a defined period this pilot test can be used to:

- Gather preliminary evidence on fatigue-related driving events
- Test the FDT's effectiveness in relation to your fleet and drivers
- Test its durability in the intended vehicles
- Gather driver feedback on use of the FDT.
  Is it easy to use? Comfortable?
  Does it obstruct vision or interfere with driving or other work tasks?
- Test the FDT's reliability – particularly in various environments such as hot or cold temperatures, rural and regional locations.
- Assess whether the information/data/video collected by the FDT is useful for making decisions?
- Assess whether the data is easy to access and easy to understand?

The pilot can also be used to gather information and data to assess the potential workload, resources and skills required for ongoing FDT-related administration.

The pilot test provides a timeframe to confirm whether the FDT works as described and if there are any issues or problems that will impact workflows. This can help to determine if it is right for your organisation and it can help smooth a subsequent wider FDT rollout.

## Define responsibilities and timelines

Depending on the size of the organisation, several key roles can be defined to ensure smooth implementation of the FDT. These can include:

- **Primary sponsor.** This role would have overall responsibility for authorising funding of the project and controlling the allocation of resources (people and systems), and it would also help to determine scope and timing. This role would also lead the implementation from top down.
- **Project team.** This will vary in size depending on the organisation and will include experienced team members who would lead the practical implementation. It might include fleet specialists, technical or mechanical expertise, change management, training and human resources specialists. This team could also include a vendor representative.
- **People managers.** These people can include supervisors and staff associations (such as unions). They would be responsible for helping employees through the transition process and can communicate with the end users.
- **Key stakeholders.** Defining which groups within the organisation (executives, supervisors, managers and employees) are affected by the change, and which external partners, such as vendors, will support the implementation.

Anyone with a defined role in implementing FDT should familiarise themselves with the selected system so that they also understand how the system works before the wider roll-out.

Implementing an FDT into your organisation will require clear and transparent project timelines that outline the expected steps/processes and their associated timelines. A good project timeline will help:

- Define implementation tasks, their order and who is responsible.
- Define implementation deadlines.
- Identify roadblocks or potential delays.
- Monitor progress of the implementation.
- Improve communication for the project team.

## Communicate the plan

A key part of FDT implementation is ensuring clear and regular communication with all levels of the organisation. A good communication plan with open and ongoing dialogue will help to drive engagement and make end users more willing to embrace the introduction of the FDT. Communication must clearly explain:

- Why fatigue is a concern for the workplace using actual de-identified data (if possible) to support this concern.
- How introducing the FDT aligns with the organisation's safety culture and goals, emphasising why the organisation is taking this path (e.g. to make drivers safer).
- How the FDT will provide positive outcomes for both the drivers and the organisation.
- Highlight the potential opportunities for improvements to users' health and safety.
- Provide an overview on any supporting materials that will be introduced as a part of implementing the FDT, such as policies, procedures and training materials. These should be developed before implementation.
- Address concerns related to the barriers defined in this document. For example, who will have access to the data, how long will it be retained, and what will the data be used for? And what are the consequences of a fatigue alarm? (provide reassurance that it is not to penalise but rather to improve driver safety).

## Implement training

Training on the benefits of the FDT and how to use it will be a crucial step in a smooth implementation.

Training should be made available to all staff who will interact with the FDT; this may require a range of different training methods to ensure appropriate support for the end users. This can include:

- General training on fatigue and fatigue driving.
- Walk through demonstrations and workshops to explain the FDT and how it works.
- Dedicated hands-on training sessions to allow users to interact with the FDT before implementation to fully understand the system's functionality.
- Provision of self-guided learning materials.
- Planned post-implementation refresher training.

A comprehensive training package can help to create a safe and supportive environment that empowers employees to learn and test the FDT without fear of repercussions or judgement. Enabling two-way feedback (between trainers and employees) will also foster a culture of continuous improvement for the implementation process.

## Roll-out of the FDT

During the roll-out of the FDT it is important to ensure experienced staff are on hand (this can be the project team) so employees have ample opportunities to provide feedback or ask questions during this phase. This can help to identify any unforeseen issues or barriers that might impair a smooth implementation.

This can also be a good time to provide refresher training and to recognise the positive changes the FDT is making to your organisation and to the safety of the drivers. Both measures can also help address any lingering employee concerns.

## Ongoing monitoring

Following implementation, it is important to have continuous monitoring on how the FDT is working across the organisation in case any issues arise or changes are needed. Ongoing monitoring can include:

- Regular feedback sessions with drivers and their supervisors.
- Additional training if needed.
- Analysing incidents to support drivers' health (e.g. identifying underlying conditions such as sleep apnoea).
- Analysing FDT data to support organisational safety improvements.
- Regular evaluation to ensure the FDT system continues to meet the organisation's objectives.
- Regular review of new FDT developments to ensure the system used by the company remains the best choice.

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### Further information

For more information about the research project undertaken to inform this guide,

- please visit: aaa.asn.au/research-data/road-safety-research-program
- or email: research@aaa.asn.au

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