The Alertness Toolkit –
A Motor Carrier's Guide to Fatigue Management Technologies (FMT)

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Please pardon our French

French captioning is auto-generated by PowerPoint

Presenter

Rodolfo Giacoman
Fatigue Management Program Specialist
Commercial Vehicle Safety Alliance

Rodolfo.Giacoman@CVSA.org

Slides & Recording

These presentation slides available in live chat

Recording & slides will be available at
nafmp.org/webinars/

Disclaimer

- Technology is on a continual path of evolution
- FMTs available today may not be available in the future
- Webinar is not meant as a recommendation or endorsement of any FMT
- Broad overview of FMTs on the market to address fatigued driving
- Vendor claims and/or system specifications have not been validated
- Costs for specific FMTs vary widely and may be impractical for your fleet
- Again, this webinar is meant to inform, not endorse

Overview

1. Overall FMP and NAFMP resources
2. FMT classifications and definitions
3. FMT implementation considerations
4. Overview of FMTs
   - NAFMP 2012 FMT Review
   - Netherland's 2020 FMT Review Report
   - Australia's FMT 2019-2020 Trial
5. Wrap-up: Future events, favor, questions, feedback

NAFMP Module 10

Fatigue Management Program (FMP)

1. Safety Culture
2. Fatigue Risk Management System
3. Sleep Disorder Management Program
4. Scheduling Practices & Fatigue Management Technologies
5. Education & Training

NAFMP Resources

1. nafmp.org
2. Implementation Manual
3. eLearning Platform
4. Train-the-Trainer: Module 5
5. PowerPoint Presentations
6. ROI Calculator
7. Webinars - Live & Recorded

nafmp.org

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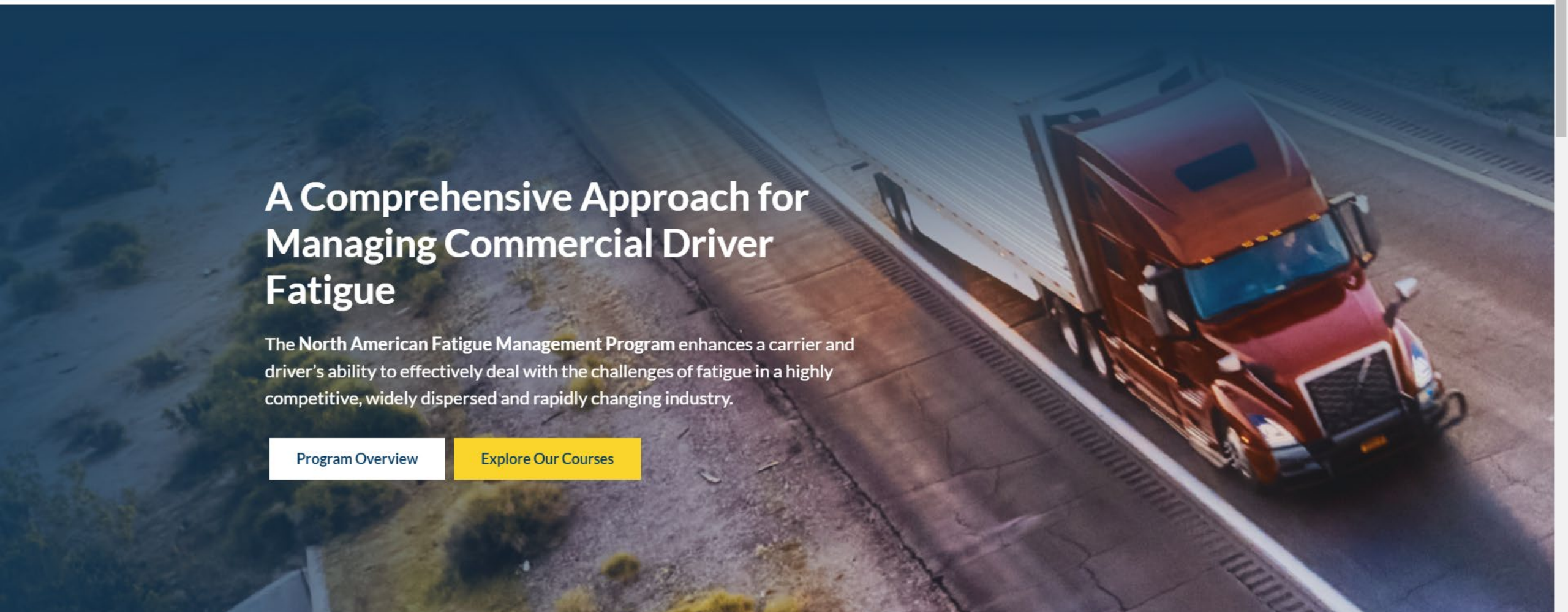
Français English

NAFMP North American Fatigue Management Program

About NAFMP | Improve Driver Safety | Training | ROI Calculator | Contact | Webinars

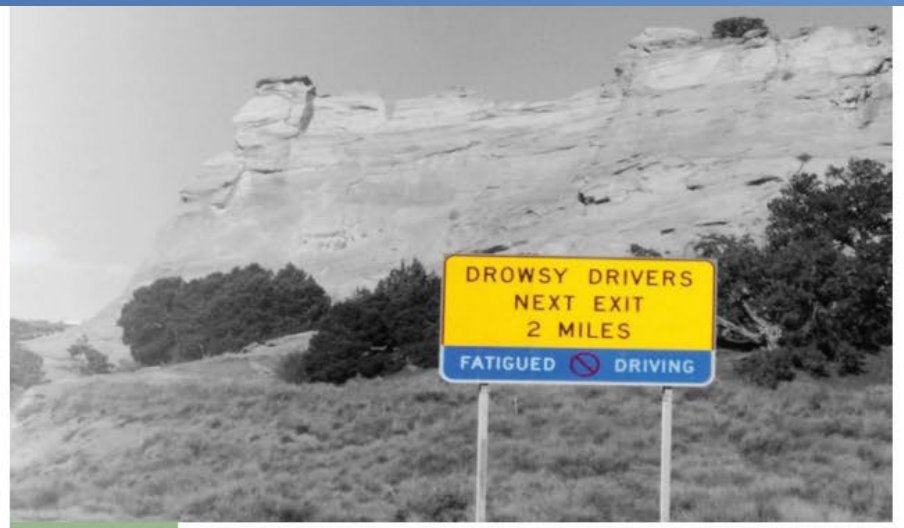


A Comprehensive Approach for Managing Commercial Driver Fatigue

The **North American Fatigue Management Program** enhances a carrier and driver's ability to effectively deal with the challenges of fatigue in a highly competitive, widely dispersed and rapidly changing industry.

Program Overview | Explore Our Courses

Implementation Manual



Guidelines and Materials to Enable Motor Carriers to Implement a Fatigue Management Program

IMPLEMENTATION MANUAL

Sponsored by the North American Fatigue Management Program

NAFMP
North American Fatigue Management Program

eLearning Platform: lms.nafmp.org

NAFMP English (en) You are not logged in. (Log in)

NAFMP North American Fatigue Management Program

Fatigue Management Community Forum

No matter your role in managing fatigue, you are welcome to join in the conversation. Questions, comments, and feedback are encouraged. Thank you for your participation. Please select here to log in or create a new free account.

Search courses

Available courses

Module 01

FMP Introduction and Overview

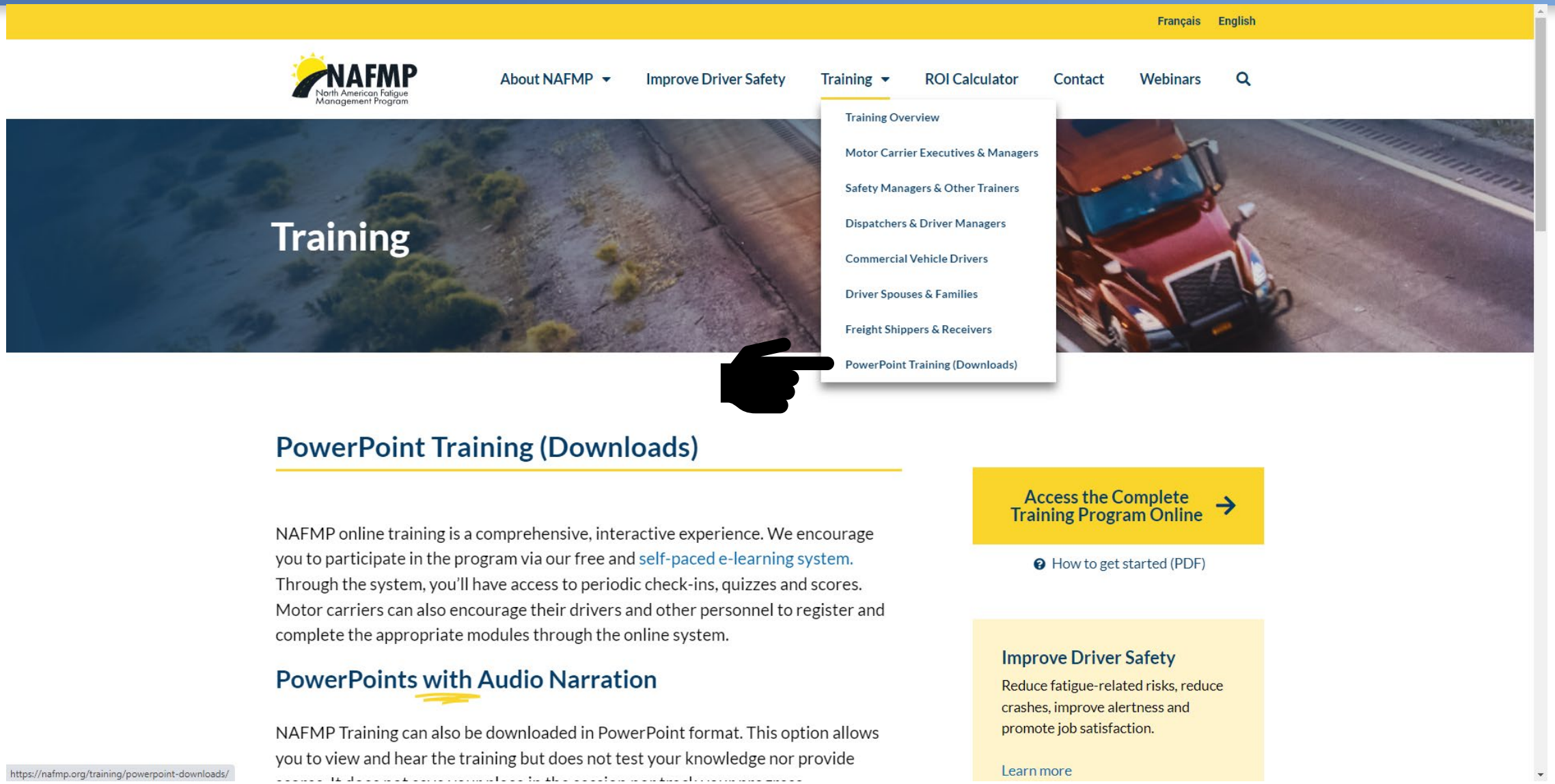
Target Audience: Carrier executives and other managers
Estimated Duration: 45 min

Module 02

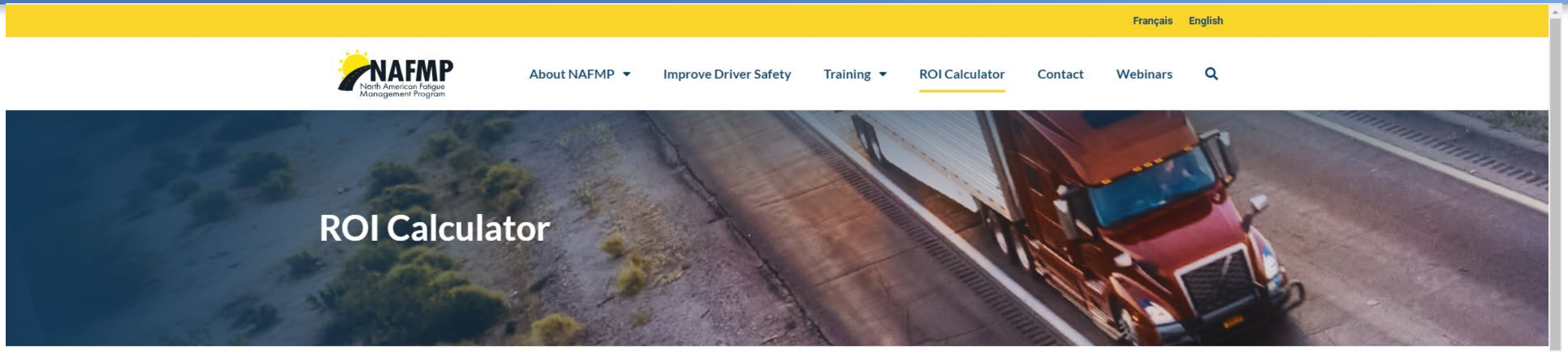
Safety Culture and Management Practices

Target Audience: Carrier executives and other managers
Estimated Duration: 1.5 hours

PowerPoint Presentations



ROI Calculator



Return on Investment (ROI) Calculator

Estimate the monetary benefits of implementing the North American Fatigue Management Program either in its entirety or in select components in a customized program, i.e., fatigue management training, sleep disorder screening and treatment, technology deployment, and scheduling tools.

Click on the links below to download the ROI Calculator and User Guide:

Calculator User Guide (PDF)

Calculator Download (Excel Spreadsheet)

Access the Complete Training Program Online →

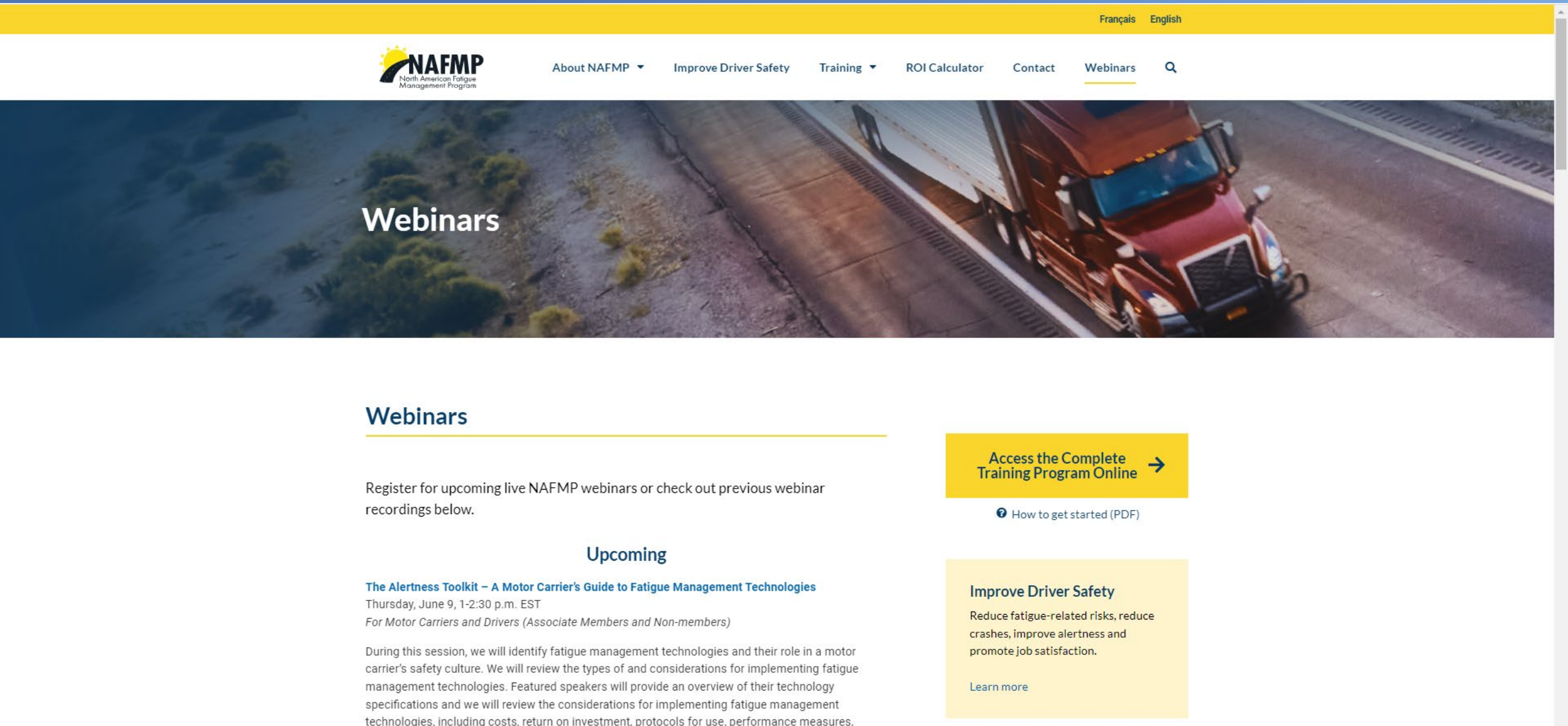
How to get started (PDF)

Improve Driver Safety

Reduce fatigue-related risks, reduce crashes, improve alertness and promote job satisfaction.

Learn more

Webinars – Live & Recorded



FMT Poll

- Have you driven a vehicle with a lane departure warning system?
  1. Yes
  2. No

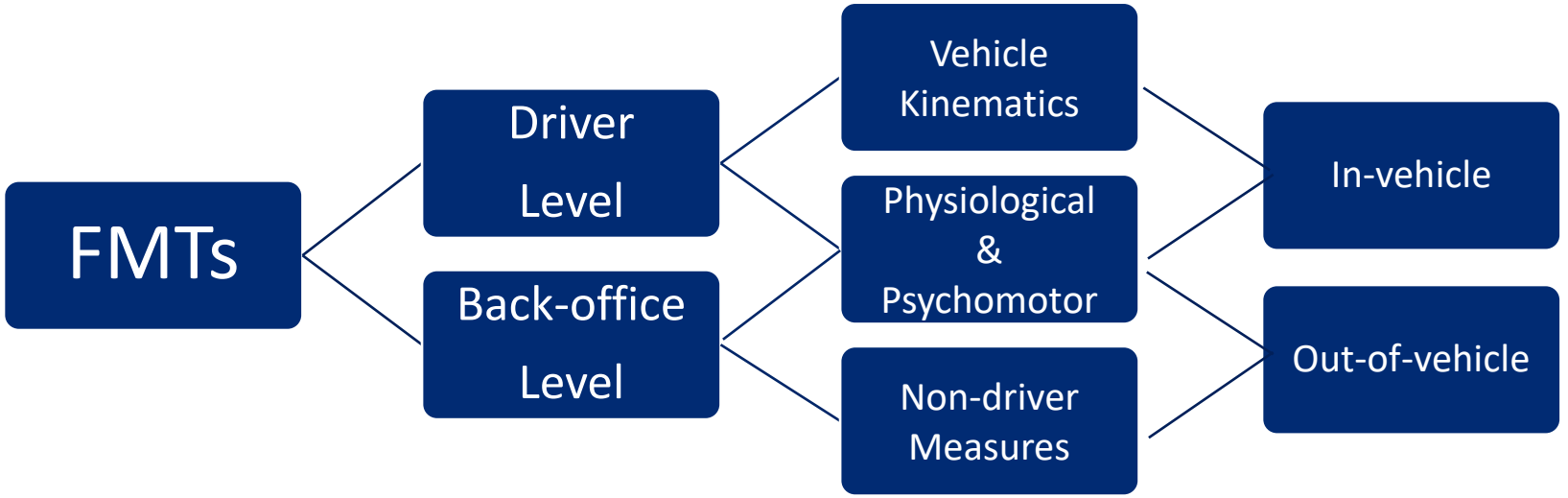
- Have you driven a vehicle that alerts you when you close your eyes, nod your head down or get distracted while driving?
  1. Yes
  2. No

- Have you used a wearable device, like a smart watch, that tracks your vital signs, activity and rest?
  1. Yes
  2. No

- Have you used software that based on the wearable device data, it tells you when it’s optimal for you to work, exercise and sleep?
  1. Yes
  2. No

NAFMP FMT Definition & Classifications

- Systems designed to recognize and mitigate driver fatigue with the goal of warning drivers and reducing fatigue related driving errors



Classifications and relationships of FMTs

NAFMP FMT Types

- Physiological
  - Actigraphy
  - Eye Measures
- Vehicle Kinematics/Driver Input
- Behavior-Based Coaching
- Psychomotor Skills - Cognitive function
- Scheduling & Trip Planning
- Single vs. Multi-Channel Systems

Back-Office Level FMTs (1 of 3)

- The **first** line of defense against driver fatigue
  - Aimed at prevention
- Key personnel involved
  - Transportation directors
  - Safety managers
  - Dispatchers
  - Driver trainers
  - Medical staff
  - Office personnel

Back-Office Level FMTs (2 of 3)

- Out-of-vehicle FMTs
  - Occur prior to a driver beginning a shift
  - Non-driver measures (e.g., scheduling)
  - Driver physiological measures/psychomotor skills
- Out-of-vehicle FMT descriptions
  - Driver scheduling software
  - Trip planning/routing software
  - Fit-for-duty testing

Back-Office Level FMTs (3 of 3)

- In-vehicle technologies
  - Designed to monitor driver and roadway with video
  - Some systems include data from vehicle (i.e., speed, braking, GPS)
  - Video and data are collected then evaluated
- Risky driving behavior reviewed and analyzed
- Driver coaching and training

Driver Level FMTs (1 of 3)

- The **final** line of defense against driver fatigue
  - Identify and alert driver of impending fatigue
- Pre-drive monitoring
  - Driver physiological measures/psychomotor skills
- Real time driver monitoring
  - Last stop-gap countermeasure
  - Driver physiological measures/psychomotor skills
  - Vehicle kinematics/driver input

Driver Level FMTs (2 of 3)

- Out-of-vehicle FMTs
  - Prior to driving shifts
    - Fitness-for-duty testing
    - Actigraphy

Driver Level FMTs (3 of 3)

- In-vehicle FMTs
  - Continual monitoring with feedback and alerts
- In-vehicle FMTs descriptions
  - Eye measurements
  - Lane monitoring
  - Steering input
  - Reaction time
  - Actigraphy

Physiological FMTs (1 of 3)

- Eye (ocular) measures
  - Perclos
    - Percent closure of the driver's eyelids over the pupil
  - Amplitude Velocity Ratio
    - How fast and how far the eyelid opens after closure

Physiological FMTs (2 of 3)

- Actigraphy
  - Uses predictive sleep algorithms to determine driver's sleep quantity and sleep quality, along with rest and activity patterns
  - May also incorporate circadian rhythm analysis
  - General indicator of night-to-night sleep variability
  - Light sensor, temperature, and off-wrist detection available on some models
  - Typically a wrist worn device

Physiological Concepts (3 of 3)

- Potential limitations to consider…
  - Eye measures
    - Potential false alarms for mirror and in-cab device glances
    - Sensitivity of camera and Infrared (IR) with respect to different lighting conditions
    - Driver resistance to systems that require glasses to be worn
  - Actigraphy
    - Predictive technology and not real time
    - Does not take into account individual differences
    - Driver must wear device

Psychomotor Skills FMTs (1 of 2)

- Combinations of hand-eye coordination in manipulation of object controls
- Cognitive functions generate automatic/instinctive psychomotor responses
- Tests of cognitive function
  - Objective process
  - Hand-eye coordination
  - Reaction time
  - Short and non-invasive
- Used as fitness-for-duty predictor

Psychomotor Skills FMTs (2 of 2)

- Potential limitations to consider…
  - Prior to driving
    - Must be administered by back-office personnel
    - Does not take into account possible onset of fatigue at a later time during driving shift
    - Possibility of beating the system
  - During driving
    - Additional task for driver to perform while driving
    - Added cost of possible inattention

Behavior-Based Coaching FMTs (1 of 2)

1. In-vehicle driver monitoring
2. Video and data reviewed and analyzed
3. Driver coaching and training on performance
4. Driver returns to the field with new knowledge and/or techniques

Behavior-Based Coaching FMTs (2 of 2)

- Potential limitations to consider…
  - Coaching takes place after risky driving behavior occurs
  - Drivers may view required coaching as punishment
  - Drivers must be willing to listen and learn
  - Some systems may require monthly fee to access recorded video and/or data

Vehicle Kinematics/Driver Input FMTs (1 of 2)

- Lane tracking
  - Computer-based algorithms using a camera, machine vision, and vehicle state to monitor lane position
  - Warns driver when deviating from travel lane
  - Typically referred to as Lane Departure Warning Systems (LDWS)
- Steering input
  - Sensor used to detect amount of steering input
  - Warns driver when programmed limits are met

Vehicle Kinematics/Driver Input FMTs (2 of 2)

- Potential limitations to consider…
  - Lane tracking
    - Requires visible lane markings; night, adverse weather (e.g., snow), and faded lane markings may render the system ineffective at times
  - Steering input
    - Potential false alarms during driving conditions which require rapid and/or multiple steering inputs (e.g., off highway driving)

Single Vs. Multi-Channel FMT Systems

- Single channel system relies on one predictor of fatigue
  - Potential for intermittent data loss
- Multi-channel system combines two or more predictors of fatigue
  - Creates a more robust system

Making Sense of FMTs

- Must be scientifically and operationally sound
- Not all FMT concepts will work for every fleet
- All FMT concepts contain limitations
- Some FMT concepts overlap
  - Occur both at the driver level and back-office level
  - Occur both out-of-vehicle and in-vehicle
- All systems are not created equal
- Designed to aid the driver, not solve the problem

No Silver Bullet

- FMTs are only one piece of the puzzle
- Must be used within an overall FMP to shape positive safety culture
- However, when used correctly, technology can reshape driving behavior leading to fewer driver errors

Implementation Considerations

- Cost & ROI
- Legal implications
- Driver
  - Behavior
  - Compliance
  - Performance measures
  - Acceptance
  - Training
- Operational protocols, problems & evaluation
- Best practices

FMT Cost

- Often a limiting factor when determining use
  - Initial purchase price
  - Return on investment
  - Fleet size and locations
  - Training
- Financing vs. outright purchase
- Must look at the big picture

Return On Investment

- May be viewed as the most important aspect for FMT fleet integration
  - Impact of avoiding just one fatigue-related crash per year
- Indirect cost benefits should also be considered
  - CSA score, cost of driver replacement, environmental clean up, etc.
- Other factors that play a role on ROI
  - Fleet size
  - Self insured vs. non-self insured
  - Type of operation

Return On Investment:
Lane Departure Warning System Example

- LDWS have shown direct cost benefits (ATRI, 2009)
  - Benefits over five-year period outweigh costs of purchasing, installation, and maintenance
  - Payback periods (time to recoup initial cost) vary depending on annual vehicle miles traveled (VMT)
  - For every $1 spent on LDWS, more than $1 in benefits were returned across all groups

Average VMT	Low End	High End
80,000	$1.54	$3.03
120,000	$2.31	$4.54
160,000	$3.09	$6.06

Anticipated benefits per dollar spent on LDWS (no financing). Adapted from Houser, A. et al. (2009).

Fleet Size & Locations

- Number of power units
  - Affects initial purchase costs
  - Vehicle out-of-service time
  - Drivers
- Terminal/shop locations
  - Single versus multiple installation locations
  - Affects cost & personnel resources

Potential Legal Implications

- Consider company policies and procedures
  - Driver video
  - Driver and vehicle data
  - Use of video and data
- Awareness of security concerns
  - Storage of collected video and data
  - Who has access to video and data

Driver Behavior: Possible Influences

- Potential for creating positive or negative effects
  - Both cannot occur concurrently
- The positive
  - Promotes greater self awareness
  - Reshapes driving habits and routines
  - Encourages safety conscious work environment
- The negative
  - Reliance on FMT to prevent crashes and near crashes
  - Complacency in driving
- Reinforces the need for an overall positive safety culture to eliminate the negative side of the coin

Policies for Driver Compliance

- Constructed by the fleet FMP Steering Committee
- Establish before FMT installation
- Clear and concise
  - What are the compliance standards?
  - Penalties for non-compliance
- Thoroughly discussed with all drivers
  - Safety meetings
  - Posted in terminals/dispatch office
- Maintain the standard
  - Do not selectively enforce
  - Drivers must be held accountable for their actions

Driver Performance Measures

- FMTs that record data or transmit in real time
- Goes hand-in-hand with driver compliance
  - Performance measures must be reasonable
  - Driver has sufficient knowledge and training to meet the minimum performance level
- Back-office
  - Analysis and review in a timely manner
  - Driver training/coaching to meet minimum performance level

Driver Acceptance

- Critical ingredient to successful FMT implementation
- Set the example from the top down
- Provide validity, facts, and benefits
- Emphasize driver assistance and not continual supervision
  - Not “big brother”
- Remain open minded to questions, apprehension, and suggestions
- Ensure drivers do not view FMTs as punishment

FMT Training

- Shop technicians (in-vehicle FMTs)
  - Proper installation techniques
  - Routine FMT inspection
- Drivers
  - How the FMT functions
  - What to expect
  - Type(s) of alerts if applicable
  - What to do when alerted
  - Observing the FMT in action
  - Avoiding negative driver responses
    - Keep in mind that without driver acceptance, not likely to be successful

Operational Protocols

- Predefined written procedures
  - Creates standardized format and method
  - Ensures end result can be replicated regardless of personnel
  - Detail oriented and easily accessible
- Potential protocol needs
  - FMT installation and maintenance
  - Driver training
  - Driver non-compliance
  - Data analysis, review, and storage

Fundamental Technology Problems

- Single channel FMTs are most common
- Potentially no independent review and validation of system
- Driver acceptance
- Technology never stops evolving
  - What is here today, may be gone tomorrow
  - However new technologies may be available

FMT Evaluation

- Research the new technology
  - University and government studies
  - Current testing
- Contact vendor for specifications and cost
  - FMT classification and concept
  - Technical documentation
  - Expected service life
- Create benchmarks for comparison to current FMTs of same concept
- Determine projected cost-benefit of new FMT

Best Practices

1) Must be integrated into overall FMP
2) Take full advantage of the FMT capabilities
3) Develop well-defined protocols
4) Explain the role of FMTs with drivers
5) Create meaningful driver expectations
6) Present consistent and detailed feedback for drivers
7) Maintain a positive atmosphere
8) Reinforce that safety is everyone's responsibility

Questions

Any questions so far?

NAFMP: Physiological FMTs - Actigraphy

System	Vendor	User Interface	Driver Feedback	Cost (US$) per System
Motionlogger®	Ambulatory Monitoring, Inc.	Wrist worn watch	Visual Auditory	$1,295.00^
Readi/Watch™	Fatigue Science	Wrist worn watch	None	$300.00^
Actiwatch Spectrum	Phillips	Wrist worn watch	None	Contact for pricing^
SOMNOwatch	SOMNO Medics	Wrist worn watch	None	Contact for pricing^

- Available FMT pricing as of May 2012

^ Additional software and cable/docking station needed for one time cost.

NAFMP: Physiological FMTs – Eye Measures

System	Vendor	Performance Metrics	User Interface	Driver Feedback	Cost (US$) per System
EA401 Driver Fatigue Monitor	EyeAlert™	Perclos	Dash mounted camera	Auditory	$485.00
Alertness Monitoring System	Optalert	Amplitude velocity ratio	Driver worn glasses and dash mounted LCD	Visual	$4,000.00
Drowsiness State Sensor	seeingmachines	Perclos	Dash mounted camera	Auditory	Contact for pricing

- Available FMT pricing as of May 2012

NAFMP: Vehicle Kinematics/Driver Input FMTs

System	Vendor	Performance Metrics	User Interface	Driver Feedback	Cost (US$) per System
Autovue LDWS	Bendix Commercial Vehicle Systems	Lane tracking	Windshield mounted camera and under dash computer	Auditory	$830.00^
Mobileye C2-270	Mobileye	Lane tracking	Dash mounted display	Auditory	Contact for pricing
Advisory System for Tired Drivers (ASTID)	Fatigue Management International	Steering input, sleep pattern, type of driving	LCD & LEDs	Visual Auditory	$1000.00

- Available FMT pricing as of May 2012
^ Additional software required for data recording

NAFMP: Behavior-Based Coaching FMTs

System	Vendor	Performance Metrics	User Interface/Location	Cost (US$) per System
Drivecam (now Lytx)	Drivecam	Forward and in-cab video, vehicle state	Windshield mounted	$495.00^
DV101E	Rosco Vision	Forward and in-cab video, GPS, and speed	Windshield mounted	$831.88*
Smartdrive (now with Omnitracs)	Smartdrive Systems	Forward and in-cab video	Windshield mounted	Contact for pricing^

- Available FMT pricing as of May 2012
* Base price
^ Additional monthly fee required

NAFMP: Psychomotor FMTs

System	Vendor	Performance Metrics	User Interface	Cost (US$) per System
Critical Tracking Task	Systems Technology, Inc.	Hand-eye coordination	Back office	$4,500.00
PVT-192	Ambulatory Monitoring, Inc.	Reaction time	Back office	$2,500.00
Reactive Fatigue Warning System (Now MAXXfleet)	C-track	Reaction time	Dash mounted	Contact for pricing

- Available FMT pricing as of May 2012

NAFMP: Scheduling & Trip Planning FMTs

System	Vendor	Application	User Interface	Cost (US$) per System
FAID Quantum	Faid Safe (Now InterDynamics)	Fleets	Back-office PC-based	Contact for pricing
Circadian Alertness Solutions	Circadian®	Fleets	Back-office PC-based	Contact for pricing
Readi/Analytics™	Fatigue Science	Fleets	Back-office PC-based	$7,500.00*
Rand McNally Fleet Management Platform	Rand McNally	Fleets	Dash mounted touch screen LCD	$800.00

- Available FMT pricing as of May 2012
* Cost is for a single two-year license for one computer.

Fatigue & Distraction Detection Report

- 2020 Review of Commercially Available Devices to Detect Fatigue and Distraction in Drivers
- By Institute for Road Safety Research in the Hague, Netherlands
  - Stichting Wetenschappelijk Onderzoek Verkeersveiligheid (SWOV)
- Commissioned by
  - Shell Global Solutions International B.V.
  - BP International Limited
  - Total S.A.
  - Chevron Services Company
- Provides a detailed comparison of ≈100 technologies
- Recommendations on devices to consider for further testing/use

SWOV Report Conclusions

- Due to extensive scientific evaluation, low cost, and high acceptability, fitness-for-duty tests score best. These systems do not monitor fatigue in real time
- Real-time systems, with the most promising candidates being EEG and computer vision systems. It is not clear how acceptable these devices would be to drivers
- A broad field study is recommended, which may also include systems that combine activity tracking and computational modelling and an established method using eyelid closure and steering movements
- If the aim is to monitor fatigue and distraction in real-time, only computer vision that focus on the driver are plausible candidates but drivers may find these devices difficult to accept
- Overall, there appears to be no single perfect fatigue/distraction system that meets all requirements; a combination of devices and methods may be needed

SWOV FMT Categories & Types

- FMT Categories: 1. Operator monitoring, 2. Performance monitoring, 3. Fitness for duty tests
- Device Types
  - Heart rate measurements
  - Head nodding
  - Camera Systems
    - Without computer vision
    - With computer vision
      - Road monitoring
      - Driver Monitoring
      - Road & Driver Monitoring
  - Activity trackers
  - Fatigue models
  - Temperature monitoring
  - EEG systems
  - Skin conductance
  - Fitness for duty tests
  - Steering movements
  - Eye tracking
  - PERCLOS

SWOV Report Review Criteria

Five points scale: −− − +/− + ++

1. Validity

   Device should respond when the person is showing signs of fatigue or distraction

2. Intrusiveness

   Device that interferes strongly with the driving or the driver is likely to be abandoned

3. Availability
   - Which development stage the product has reached, and how long the product has been on the market, and whether there are signs of continuous development and evaluation, and whether customer support is provided

4. Robustness
   - Device works for different drivers, and under different driving conditions

5. Acceptability
   - Devices that need to be worn or interfere with driving may score low on this criterion, but also devices that record the driver and send the information into the cloud for further processing may cause privacy issues and be less accepted

6. Sustainability
   - How frequently the device needs to be charged, needs replacing or repairing

7. Cost
   - Purchasing the system, any subscription fees or maintenance plans, or costs for repairs and replacements

8. Compatibility
   - Does system interfere with other systems inside the vehicle, such as communication devices, or navigation systems

SWOV: Heart Rate (HR)/HR Variability

Device	Validity	Intrusiveness	Availability	Robustness	Acceptability	Sustainability	Cost	Compatibility
Warden	–	+/–	–	–	+/–	–	NA	+/–
Holux DFD-100	+/–	–	–	–	–	–	NA	–
Canaria	–	+/–	–	+/–	–	–	NA	–
Holux WRL-8110	–	+/–	–	–	+	–	NA	+/–

SWOV: Head Nodding

Device	Validity	Intrusiveness	Availability	Robustness	Acceptability	Sustainability	Cost	Compatibility
Co-pilot	–	+/–	+	–	–	+/–	–	–
Alert Me	–	–	+	–	–	–	+	–
Safeguard	–	–	– –	+/–	–	– –	NA	–

SWOV: Camera Systems -Without Computer Vision

Device	Validity	Intrusiveness	Availability	Robustness	Acceptability	Sustainability	Cost	Compatibility
MTData	–	+/–	+	+	+/–	–	+/–	+
SmartDrive	+	–	+	+/–	–	+	NA	–
Lytx	+/–	–	++	++	–	+	NA	+/–

SWOV: Computer Vision –Road Monitoring

Device	Validity	Intrusiveness	Availability	Robustness	Acceptability	Sustainability	Cost	Compatibility
Mobileye	–	+/–	+	–	+	+	NA	+
Autovue	–	+/–	+/–	+/–	+	+/–	NA	+
Safetrak	+	+/–	–	+/–	+	–	NA	+

SWOV: Computer Vision – Driver Monitoring

Device	Validity	Intrusiveness	Availability	Robustness	Acceptability	Sustainability	Cost	Compatibility
Stonkam	+/–	+/–	+	+	+/–	+/–	+	+/–
MR688	+/–	+/–	+/–	+	–	+	+	+/–
TS DFM	–	+/–	+	+	+/–	+	+/–	+/–
Abto	–	+/–	–	–	+/–	+/–	NA	+/–
Delphi	+	–	–	+	+/–	–	NA	+/–
Guardvant	+/–	–	+	+	–	+/–	NA	+/–
Eyesight	+/–	–	++	+	+	++	–	+/–
F16 System	+/–	+/–	+/–	–	+/–	–	++	+/–
Guardian	+	+/–	++	+	–	++	–	+/–
Soteria	+/–	+/–	–	–	–	–	NA	+/–
SmartTrans	–	–	–	–	+/–	–	NA	+/–
HxGN Mine Protect	–	+/–	+/–	+	–	+/–	NA	+/–
Toucango	–	+/–	+	+/–	+/–	+/–	–	+/–

SWOV: Computer Vision – Road/Driver Monitoring

Device	Validity	Intrusiveness	Availability	Robustness	Acceptability	Sustainability	Cost	Compatibility
Idrive	+	+/–	+/–	+/–	+/–	+/–	NA	+/–
Exeros	–	+/–	+	+/–	–	+/–	NA	+/–
Zendu Cam	–	–	+/–	–	–	+/–	NA	+/–
Nauto	+	–	++	+	–	++	+	+/–
Streamax	+/–	+	++	+	+	+	+/–	+/–

SWOV: Activity Trackers

Device	Validity	Intrusiveness	Availability	Robustness	Acceptability	Sustainability	Cost	Compatibility
Readiband	+	+/–	++	+/–	+/–	+	+/–	+/–
Cat Smartband	+	+/–	++	+/–	+/–	+	+	+/–
CAS–5	++	+	++	+/–	+/–	++	NA	+
Bodycap	–	–	+	–	–	–	+	+/–

SWOV: EEG Systems

Device	Validity	Intrusiveness	Availability	Robustness	Acceptability	Sustainability	Cost	Compatibility
Smart Cap	+	–	++	+	–	+	NA	–
B-Alert	++	–	++	+/–	–	++	+	–
Emotiv	++	–	++	–	–	+/–	+/–	–
DSI 10/20	+	–	+	+	–	+	–	–
Freerlogic	–	+	–	–	+	–	NA	+

SWOV: Skin Conductance

Device	Validity	Intrusiveness	Availability	Robustness	Acceptability	Sustainability	Cost	Compatibility
EDVTCS	–	–	+	+/–	+	++	–	–
StopSleep	+/–	+/–	+	+/–	+/–	+/–	+/–	+/–

SWOV: Fitness-for-Duty Tests

Device	Validity	Intrusiveness	Availability	Robustness	Acceptability	Sustainability	Cost	Compatibility
FIT	+	+	+	+/–	+	++	+/–	+
Fatigue-o-meter	+/–	+	++	+	+	++	+	+
OSPAT	+	+	+	+	+	++	++	+
PVT	++	+	++	++	++	++	++	+
EyeCheck	–	+	–	–	+/–	–	+/–	
2B-Alert Web	+/–	++	++	–	+	+	++	+/–
Pulsar informatics	+	+	+	+/–	+/–	+	+	+
DriveABLE	++	–	+	+/–	–	++	–	+

SWOV: Steering Movements

Device	Validity	Intrusiveness	Availability	Robustness	Acceptability	Sustainability	Cost	Compatibility
ASTiD	+/–	+	+	+/–	+	++	NA	+
Bosch / Mercedes	–	+	+	+/–	+	++	NA	+

SWOV: Eye Tracking

Device	Validity	Intrusiveness	Availability	Robustness	Acceptability	Sustainability	Cost	Compatibility
SmartEye	+	–	++	+	+	++	+/–	–
Vigo	–	–	+	–	–	+/–	+	–
SmoothEye	–	+	+/–	–	+	–	+	+
Ellcie	+/–	–	+	+/–	+/–	+/–	+	–

SWOV: PERCLOS Systems

Device	Validity	Intrusiveness	Availability	Robustness	Acceptability	Sustainability	Cost	Compatibility
Optalert	++	+/–	++	+	+	++	–	+/–
DD850	+/–	+/–	+	+/–	+/–	+	+	+

SWOV: Other

- Fatigue Model: CAS-5 - Circadian Alertness Simulation
- Temperature Monitoring: Bodycap eTact and e-Celsius Performance

NHVR Trial Info

- Australia's National Heavy Vehicle Regulator (NHVR)
- Fatigue Monitoring Trial Homepage
- Phase 1 Fatigue Monitoring Trial Report Summary
- Phase 2 Research Report - Fatigue/distraction detection technology use in the Australian road freight transport sector

NHVR Trial Phase 1 Conclusions

- Oculomotor measurement devices or face monitoring systems using in-vehicle cameras provide real-time monitoring of driver fatigue and also driver distraction. These devices offer most value to users and are focus for Phases 2 and 3.
- There is limited evidence however on the reliability and validity of fatigue and distraction detection technologies, especially from independent third-party assessments
- The review indicates that devices should not be implemented as a standalone tool for fatigue management. Rather, the technology should be used as part of a Fatigue Risk Management System

NHVR Trial Phase 1 Summary

Technology	Description	Fatigue/distraction technology devices	Effectiveness of technology devices
Fitness for duty tests	Tests are generally conducted before work to determine current alertness levels of drivers.	Variety of devices that assess worker/driver performance including vigilance or hand-eye coordination. For example, OSPAT. Not suitable for ongoing detection or monitoring driver fatigue within the heavy vehicle industry.	Not suitable for ongoing detection or monitoring driver fatigue within the heavy vehicle industry.
Continuous operator monitoring - Oculomotor measurements	Fatigue/distraction technologies based primarily on eye movements.	Optalert, CoPilot /DD850, Seeing Machines (DSS, Guardian), GuardVant (Opguard), LUCI, SafetyTrax DDM, Eye-Com, SmartEye, Blackbird Antisleep, DriveCam. Many oculomotor devices also detect driver distraction.	Many oculomotor devices also detect driver distraction. Only Seeing Machines technologies and Optalert had any third party assessments. Seeing machines (Guardian) have been implemented within the heavy vehicle industry.
Continuous operator monitoring – EEG - Electroencephalography	Fatigue detection based on brain wave activity.	SmartCap, B-Alert, WARDEN EEG type devices do not detect driver distraction.	Although evidence suggests EEG-type technologies do detect driver fatigue (albeit limited third party assessment) – EEG type devices do not detect driver distraction.
Other continuous operator monitoring technologies	Devices that continually measure physiological correlates of fatigue during work -	**Posture/head nodding** – Nap Zapper, Stay Awake, Driver Fatigue Alarm, NoNap, Dozer's Alarm, MicroNod, Travel Mate, Stay Alert. **Galvanic skin resistance** – (Engine driver vigilance telematics control system)	Although posture/head nodding type technology may be a predictor of driver fatigue, no third party assessments on the effectiveness of the technology for the heavy vehicle industry could be identified.
Performance based monitoring	Devices that monitor performance indicators that are associated with fatigue-related incidents.	**Embedded performance measures** – monitor task performance indicators associated with fatigue incidents (SafeTrak, MobilEye, AutoVue, Delphi, Maven Machines, CarVi, & Smartphone applications).	No current third party assessment of technologies. Limited assessed ability to predict driver fatigue and distraction, especially in the heavy vehicle industry.
Vehicle related technologies including crash avoidance technologies	Fitted vehicle safety technologies that aim to assist the driver to reduce the likelihood of a crash.	**Crash avoidance technologies** – Electronic Stability Control, trailer roll stability, autonomous emergency braking, electronic braking system, electronic brake distribution, adaptive cruise control, forward collision warning, lane departure warning.	Crash avoidance technologies do not provide any alert in relation to prediction of driver fatigue/distraction. Could be considered as an effective back-up to more driver predictive/monitoring technologies rather than the primary method to detect instances of driver fatigue.

NHVR Trial Phase 2 – Selected Findings

- Effective use of fatigue and distraction detection technology will profoundly reduce the frequency of fatigue and distraction events
- Distraction events are far more prevalent and outnumber fatigue events by a factor of four to one
- Importance of adopting a collaborative (as opposed to mandated) approach between company management and drivers
- A stated preference by most drivers to encourage the use of FMTs that identify unsafe events alerts rather than approaches based on continuous surveillance
- There is increasing industry awareness and focus through the use of FMTs on the centrality of driver fitness for duty as a key strategy to help reduce fatigue related crashes

FMT Vendor Poll

- Would you be interested in a webinar to watch FMT vendor demos?
  - Yes
  - No

- Would you be interested in a webinar to ask questions from FMT vendors?
  - Yes
  - No

- Which type of FMT are you most interested in learning more about?
  1. Operator monitoring
  2. Performance monitoring
  3. Fitness for duty tests

- What information is most important to you?
  1. Demo
  2. Effectiveness data
  3. Pricing
  4. Features
  5. Specifications

Upcoming Webinar and Course

- July 6 Webinar
  - Supporting Driver Hours-of-Service Compliance, Alertness and Productivity Through a Mutually Beneficial Partnership with Shippers, Receivers and Brokers

  nafmp.org/webinars/

- August 31 All-Day Course
  - NAFMP Train-the-Trainer

  cvsa.org/training/

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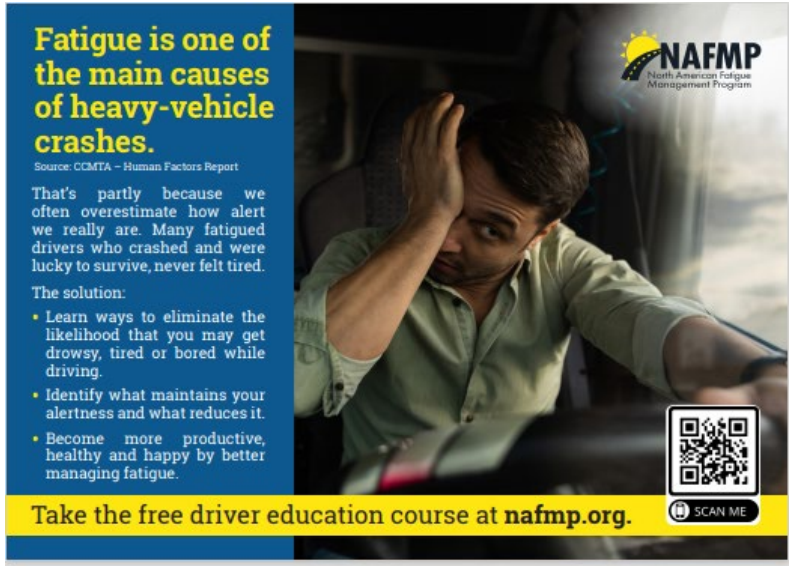

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