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Effective Use of Commercially Available Onboard Safety Monitoring Technologies: Guidance for Commercial Motor Vehicle Carriers

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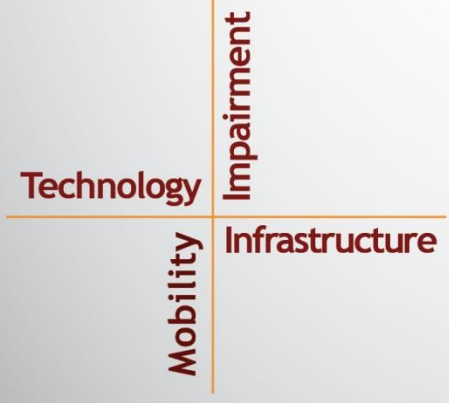

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EXECUTIVE SUMMARY

PROJECT OVERVIEW

The implementation of onboard safety monitoring (OSM) systems involves more than installing the technology in vehicles. It requires detailed planning and involvement from all levels within a fleet. Furthermore, criticism and resistance can be expected when implementing an OSM device. The purpose of this project is to provide a manual for use by fleet management personnel prior to implementing an OSM technology (or for carriers that have implemented an OSM device but who are having problems achieving results). This manual is a practical, easy-to-understand reference guide for implementing an OSM program. It includes an overview of safety culture, a step-by-step guide for implementing a behavior-based safety (BBS) program in conjunction with an OSM device, and provides a list of commercially available OSM systems.

INTRODUCTION

In 2012, commercial motor vehicles (CMVs) were involved in 12%, or 3,702, of all fatal crashes. An additional 367,000 were involved in nonfatal crashes (or 6.6% of all nonfatal crashes).[(1)] The Large Truck Crash Causation Study (LTCCS)[(2)] found that approximately 87% of all CMV crashes were the result of risky driving behaviors or driver error. Similarly, Treat et al.[(3)] found human factors (i.e., recognition errors, decision errors, performance errors, and critical non-performances) were assigned the probable cause in 92.6% of all crashes. Moreover, Hendrix et al.[(4)] found that driver behavioral errors contributed to or caused 717 out of 723 crashes. These studies show that most of the CMV crashes involved risky driving behaviors or errors on the part of the driver and thus were preventable. Yet, many drivers continue to behave in ways that put themselves and others at risk for a vehicle crash and/or serious injury by engaging in risky driving behaviors. Risky driving behaviors include violating speed limits, excessive speed and lateral acceleration on curves, unplanned lane departures, frequent hard braking, close following distances, lateral encroachment (e.g., during attempted lane changes, perhaps due to improper mirror use), failure to yield at intersections, general disobedience of the rules of the road, among others. Considering these research results, the reduction in risky driving behaviors should lead to a reduction in crashes and their associated fatalities and injuries. For example, using the findings from Treat et al.,[(3)] 3,428 CMV fatal crashes and 339,842 nonfatal crashes could have been prevented in 2012 by reducing or eliminating CMV drivers' risky behaviors.

One method to reduce risky driving behaviors is through the use of OSM technologies. These in-vehicle technologies are able to provide continuous or event-based measures on a wide variety of driving behaviors previously unavailable to fleet safety managers. Thus, OSM technologies have the potential to be used in conjunction with BBS techniques to greatly reduce a variety of risky behaviors.

What Is an OSM Device?

OSM devices incorporate in-vehicle recording technology that can continuously measure and record the driver's performance. There are two types of OSMs. The first type only records driver performance with vehicle telematics. These devices can be inconspicuously installed in the engine and connected to the vehicle's network, or they can be simple "plug and play" devices

easily inserted into the vehicle's onboard diagnostics connection. These types of OSM devices are designed to record all driving data from the vehicle's sensors and typically include an accelerometer. The second type of system incorporates in-vehicle video technology that can record the environment surrounding the vehicle, as well as the driver's behavior and performance. Camera feeds provided by these systems may include the forward roadway, the driver and inside the cab, the roadway behind the vehicle, and views of the lanes directly beside the vehicle. Video-based OSM systems can also capture performance and vehicle information from the vehicle's network and accelerometers. Regardless of the type of OSM device, many driver behaviors can be tracked and recorded, including speeding, hard braking, rapid acceleration, quick cornering, seat belt use, turn signal use, following distance, and lane departures (if the vehicle is equipped with a lane departure warning system).

Some of the capabilities of OSM devices include:

- Continuous recording of driver behavior and/or "flagging" a safety-related event;
- Saving safety-related event videos for post-trip review (only for video-based OSM devices);
- Integration into a fleet's existing back-office software;
- Providing managers with real-time alerts of safety-related events via email and/or text message;
- Providing drivers with immediate in-cab feedback via a visual, auditory, or haptic alert;
- Wireless or manual data retrieval.

Effectiveness of OSM Systems

Several studies have found OSM devices to be highly effective in increasing the safety of drivers.[5-9] For example, Hickman and Hanowski[6] evaluated the safety benefits of a video-based OSM device in two CMV fleets. They found that the combination of an OSM device with driver feedback and coaching resulted in a 52.2% reduction in safety-related events, and a 59.1% reduction in the most severe safety-related events. Additionally, results showed that the in-cab feedback alone and/or coaching sessions that did not include videos were insufficient to significantly reduce the mean rate of safety-related events. Huang et al.[9] evaluated truck drivers' opinions and perceptions of an OSM device that provided feedback on their driving behaviors. They found drivers' opinions of this technology were positive. Although drivers preferred feedback from their safety managers more than an OSM device, they indicated a desire for the OSM device to provide feedback on the safe behaviors they performed. This illustrates two critical points in designing a safety program that includes an OSM device: (1) the need for a back-office safety coaching component (as drivers preferred the face-to-face interaction with the safety manager) and (2) the program must provide feedback on safe driving behaviors, rather than only risky behaviors, or the process will be viewed negatively.

SAFETY CULTURE

OSM systems are unlikely to result in sustained behavioral improvement when implemented in the absence of a supportive safety culture. Thus, it is important to review the concepts of safety culture and strategies to improve safety culture prior to implementing an OSM program. The information presented on safety culture was adapted from the North American Fatigue Management Program's (NAFMP) educational module on safety culture.[10] The lead author of the current report was responsible for authoring the safety culture module in the NAFMP. Although the NAFMP focuses on fatigue management, the information pertaining to safety culture is relevant to any safety program.

Introduction to Safety Culture

Safety culture has remained a popular topic in the safety literature since the Chernobyl disaster in 1986;[11] however, the exact definition of safety culture has been widely debated.[12] Most people believe it is much easier to experience a company's safety culture than to actually define the concept. However, there are some common characteristics shared by most definitions, which include the shared beliefs, values, and attitudes regarding safety across employees.[13-15]

Corporate Responsibility and Roles in OSM Implementation

All employees have a role in creating and sustaining a safety culture that discourages risky behaviors, regardless of their position in the organization. Management's largest contribution to safety culture comes through communication.[15] For example, you create policies and procedures that either increase or decrease opportunities for safe performance. You are also responsible for providing feedback and rewarding safe behavior. Drivers have individual knowledge, skills, abilities, motivations, beliefs, and attitudes towards risky driving behaviors. Thus, you and your employees share a responsibility to decrease risky driving.

Effective safety cultures move away from management control (i.e., top-down control) to driver involvement (bottom-up involvement).[16] Traditionally, most safety programs and initiatives were designed, developed, and implemented by carrier management. Drivers did not have much, if any, input into the process. This led to resentment, resistance to change, and ultimately, the safety program's failure. Creating an effective safety culture involves providing employees with the power and ability to create a safety program with your support. In terms of an OSM program, an effective safety culture should create bottom-up involvement with top-down support.

An effective safety culture starts with commitment to safety. Management's support and approval for the OSM program is critical. You not only need to voice your commitment to the OSM program, you need to show your commitment. Below are seven suggestions to help you emphasize your commitment to driver safety and the importance of the OSM program. The seven suggestions include:[16]

- Value safety equal to production;
- Maintain a high profile for safety;
- Personally attend safety meetings;

- Have one-on-one meetings with drivers that feature safe driving as a topic;
- Include safety contracts in job descriptions;
- Be a safety leader;
- Emphasize the need for continued communication about the OSM program.

Engaging and Empowering Staff

Employee empowerment is often discussed in the business literature as a key to successful management initiatives and safety programs. Definitions of empowerment focus on providing organizational information and knowledge so employees can influence organizational performance and direction.[17] In terms of the OSM program, management can empower drivers by sharing information and knowledge that allow drivers to make decisions that directly influence the design, development, and implementation of the OSM program.

One of the most beneficial aspects of empowerment is that it counteracts the tendency of employees to resist new programs. New programs that are supported, developed, and/or owned by employees are more likely to succeed when compared to programs not supported or developed by the employees. OSM systems are traditionally disliked by many drivers. They believe the OSM system is designed and used to solely blame drivers for mistakes. As an OSM program is developed, empowered drivers will help make the OSM program more successful. Furthermore, empowered drivers will help to ease tensions and concerns from other drivers that are more reluctant to the change. Finally, empowerment should help to develop more accountability in the program.

Listed below are several strategies for increasing an employee's sense of empowerment. These strategies are based on self-efficacy, personal control, and optimism:

- Trust that drivers will perform safely.
- Provide supportive feedback about safe behaviors.
- Actively listen to drivers' concerns.
- Allow drivers to develop their own goals.
- Allow drivers to develop their own strategies to achieve goals.

STEP-BY-STEP GUIDE TO IMPLEMENTING AN OSM PROGRAM

Careful consideration is required when developing, implementing, and evaluating the OSM program. Each step of the OSM program is critical to its success and includes the following:

1. Develop a positive safety culture.
2. Assemble a steering committee.
3. Define roles and responsibilities in the OSM program and create an OSM program policy.
4. Benchmark risky driving.
5. Evaluate currently available OSM devices and select one for the OSM program.
6. Develop performance measures.
7. Develop an implementation timeline.

8. Develop accountability.
9. Develop awareness, education, and training.
10. Implement the OSM program.
11. Monitor and evaluate the OSM program.

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LIST OF ABBREVIATIONS AND SYMBOLS

BBS	Behavior-based safety
CDL	Commercial driver's license
CMV	Commercial motor vehicle
FMCSA	Federal Motor Carrier Safety Administration
FHWA	Federal Highway Administration
GES	General Estimates System
GPS	Global Positioning System
NAFMP	North American Fatigue Management Program
OSM	Onboard safety monitoring
SHSP	Strategic highway safety plan

CHAPTER 1. INTRODUCTION

Chapter 1 provides an overview of safety management techniques and onboard safety monitoring (OSM) systems. Although this information provides a high-level background on these topics, more seasoned safety managers and carrier personnel may want to skip to Chapter 2 for a description of safety culture.

In 2012, commercial motor vehicles (CMVs) were involved in 12%, or 3,702, of all fatal crashes. An additional 367,000 were involved in nonfatal crashes (or 6.6% of all nonfatal crashes).[1] The Large Truck Crash Causation study (LTCCS)[2] found that approximately 87% of all CMV crashes were the result of at-risk driving behaviors or driver error. Treat et al.[3] found that human factors (i.e., recognition errors, decision errors, performance errors, and critical non-performances) were assigned as the probable cause in 92.6% of all crashes, and Hendrix et al.[4] found driver behavioral errors contributed to or caused 717 out of 723 crashes. These studies show that most of the crashes were preventable as they involved risky driving behaviors or driver errors. Yet, many drivers continue to behave in ways that put themselves and others at risk for a vehicle crash and/or serious injury by engaging in risky driving behaviors. Risky driving behaviors include violating speed limits, excessive speed, excessive lateral acceleration on curves, unplanned lane departures, frequent hard braking, close following distances, lateral encroachment (e.g., during attempted lane changes, perhaps due to improper mirror use), failure to yield at intersections, general disobedience of the rules of the road, among others. Considering these research results, the reduction in risky driving behaviors should lead to a reduction in crashes and their associated fatalities and injuries. For example, using the findings from Treat et al.,[3] 3,428 CMV fatal crashes and 339,842 nonfatal crashes could have been prevented in 2012 by reducing or eliminating CMV drivers' risky behaviors.

STRATEGIES TO REDUCE CMV CRASHES

Reducing the number of CMV crashes and their resulting injuries and fatalities is the mission of the Federal Motor Carrier Safety Administration (FMCSA).[18] To achieve this mission, FMCSA employs a multifaceted strategy involving education, engineering, and enforcement (often called the "three Es"). Additionally, the Federal Highway Administration (FHWA) recommends integrating all three of these strategies when designing a strategic highway safety plan (SHSP). An SHSP is a multidisciplinary, data-driven plan to reduce roadway hazards.[19] Although SHSPs are developed by each state's Department of Transportation (DOT), SHSPs are similar to strategic safety plans developed by CMV fleets. These plans incorporate objectives, goals, performance measures, and targeted strategies to increase fleet safety. SHSPs integrate engineering, education, and enforcement strategies that, when combined, may provide the most comprehensive approach to increase traffic safety (Figure 1).

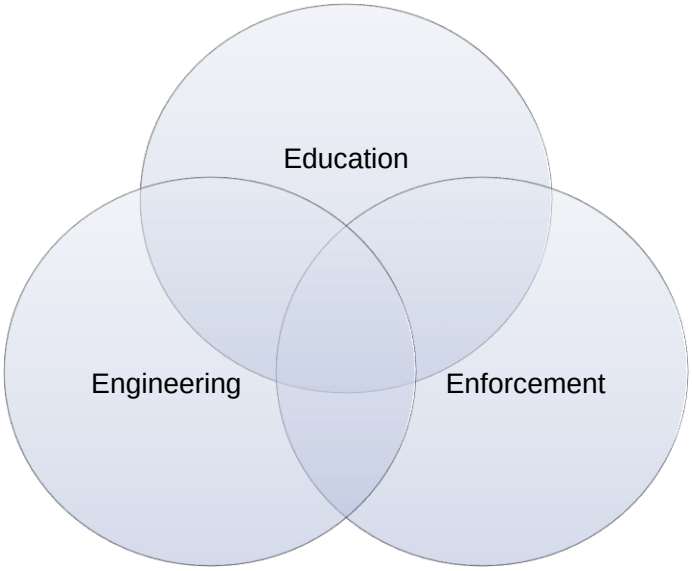

Figure 1. Three strategies to reduce vehicle crashes (adapted from FHWA).[19]

Education Strategies

Educational strategies are designed to increase drivers' knowledge of safe driving practices through increased awareness and skill development. Educational programs designed to reduce CMV crashes may include increasing the general driving public's knowledge (e.g., "share-the-road"),[20] improving commercial driver license (CDL) programs,[20] and increasing CMV drivers' awareness of fatigue and health and wellness.[21] Educational programs may include classroom or online education, flyers or posters posted in CMV terminals, newsletters, seminars, safety meetings, and behind-the-wheel training. Although education is necessary to reduce CMV crashes (a driver must have the knowledge of how to drive safely), education alone is not sufficient to guarantee and sustain behavior change (a driver may have knowledge of how to drive safely but choose not to). These programs need ongoing reinforcement through enforcement, encouragement, and environmental and engineering strategies.

Engineering Strategies

Engineering strategies focus on identifying and developing countermeasures to improve roadway safety. Some everyday engineering strategies to increase roadway safety include rumble strips, improved roadway and vehicle lighting, improved ergonomics inside a CMV, maintenance of the infrastructure, development and implementation of safety technologies (e.g., electronic stability control), and routine vehicle maintenance. Vehicle and infrastructure engineering strategies are aimed at reducing the environmental factors that may contribute to crashes. These strategies decrease the potential for crashes caused by risky driving behaviors, prevent risky driving behaviors from occurring, increase survivability in crashes, and provide drivers with information to reduce the adverse effects of risky driving behaviors.

Enforcement Strategies

Enforcement is a strategy aimed at reducing the frequency of risky driving behaviors. Enforcement serves to compliment and reinforce driver education and training. Enforcement includes the laws, regulations, and policies on acceptable behavior and the consequences for not adhering to these laws, regulations, or policies. Of course, laws, regulations, and policies are only as effective as their ability to be enforced (or the perception of enforcement). It is not so much that laws, regulations, and policies are effective or ineffective, it is how effective or ineffective the enforcement piece is that determines the success of any law, regulation, or policy.[22-26] Example enforcement strategies include roadside inspections on vehicle maintenance, laws and policies on distracted and fatigued driving, and carrier policies regarding unsafe driving practices.[20]

BEHAVIOR-BASED SAFETY (BBS)

When properly designed, BBS approaches combine education, engineering, and enforcement. BBS techniques focus on increasing safe behaviors and decreasing risky behaviors using peer observation and feedback, training and education, behavior-based incentives, prompts, and goal setting.[16,27] BBS has its scientific foundations in applied behavior analysis where continuous performance improvement through a BBS program is strictly tied to behavioral contingencies.[28] Through applied behavior analysis, BBS programs identify, measure, and track safe and/or risky behaviors, and implement strategies to increase safe behaviors and decrease risky behaviors.[29]

BBS programs first appeared in research journals in the late 1970s,[30-32] and have effectively increased safety-related behaviors in a wide variety of industries.[33] One reason BBS programs have been so successful in so many industries is their ability to reduce injuries and fatalities. Sulzer-Azaroff and Austin[34] reviewed published studies on BBS programs and found that 96.6% of the studies showed statistically significant reduction in injuries and/or risky behaviors. Additionally, Guastello[35] reviewed 53 studies involving interventions targeting safety and found BBS techniques produced the highest average injury reduction rate (59.6%) when compared to other safety interventions (e.g., ergonomics, engineering).

Although BBS programs have been shown to be highly effective at increasing safety-related behaviors, most BBS programs have been applied in work settings where employees can systematically observe the safe versus at-risk behaviors of their coworkers. In contrast, truck and bus drivers typically work alone in relative isolation and thus require alternative strategies. The primary problem with implementing BBS approaches in transportation has been getting quality behavioral data on driving behaviors. However, existing technologies are available that provide objective measures of driver behavior. These in-vehicle technologies, or OSM technologies, are able to provide continuous or event-based measures on a wide variety of driving behaviors previously unavailable to fleet safety managers. Thus, OSM technologies have the potential to be used in conjunction with BBS techniques to greatly reduce a variety of risky behaviors.

OSM SYSTEMS

OSM systems incorporate in-vehicle recording technology that can continuously measure and record the driver's performance. There are two types of OSMs. The first type only records driver

performance with vehicle telematics. These devices can be inconspicuously installed in the engine and connected to the vehicle's network, or they can be "plug and play" devices easily inserted into the vehicle's onboard diagnostics connection. These types of OSM devices are designed to record driving data from the vehicle's sensors and additional aftermarket devices. Additionally, many of these systems have Global Positioning System (GPS) functionality, accelerometers, and gyroscopes to track risky driving behaviors. Some of the driving behaviors these systems measure and record include speeding (via GPS or the vehicle network), hard braking, rapid acceleration, quick cornering, seat belt use, turn signal use, following distance (if the vehicle is equipped with forward radar), and lane departures (if the vehicle is equipped with a lane departure warning system).

The second type of OSM incorporates in-vehicle video technology that can record the environment surrounding the vehicle, as well as the driver's behavior and performance. These types of systems typically have at least two cameras. One camera records the forward roadway and shows what the driver can see through the forward windshield. Another camera records the driver and shows how the driver behaves behind the wheel and responds to driving situations. Some systems have more than two cameras. Additional camera feeds may include a rear camera that shows what is behind the vehicle, and rear facing left- and right-side cameras that show the lanes surrounding the vehicle. Video-based OSM systems can capture the same vehicle information recorded by a telematics-based OSM system. This combination provides a wealth of video and vehicle information to pinpoint problem and unsafe behaviors. Most video-based OSM systems continuously monitor the driver whenever the vehicle is on. When a safety-related event is detected, the system automatically saves a predefined amount of data (e.g., 30 s prior to the event and 60 s after the event) to memory.

OSM systems have the ability to continuously record driver behavior and/or "flag" a safety-related event. These safety-related events may be based on speed, a maximum g-force threshold, minimum headway, unfastened seat belts, etc. Flagging safety-related events allows drivers and safety managers to review the data at a later date to pinpoint what happened to prevent a similar event from taking place in the future.[6] Video-based OSM systems also allow safety managers to review the video of the event with drivers. Furthermore, OSM systems have the ability to feed into performance management software, allowing you to track a driver's performance over time to identify risky drivers.

Some OSM systems also have the functionality to provide immediate notification of a safety-related event via a text message, email, or other communication, and provide immediate notifications to drivers via an in-cab auditory, visual, or haptic alert. However, these notifications should be limited to those events that require immediate attention from the driver.[36] Limiting the notifications from the OSM system reduces the amount of data and avoids "information overload." As driving requires a great deal of visual attention, the immediate feedback provided by the OSM system should be haptic or auditory. However, auditory warnings need to be limited to immediate threats to safety, as warnings can become annoying and/or distracting when used frequently.[36] Finally, data retrieval from the OSM system may be manual or automated via a wireless connection. All data retrieved from the OSM system may be tracked, analyzed, and summarized by the vendor or by the fleet itself. This will depend on the vendor and on the fleet's preferences. Additionally, data may be stored on-site at the fleet or off-site with the vendor. Many vendors can accommodate either preference.

Effectiveness of OSM Systems

Hickman and Hanowski[6] evaluated the safety benefits of a video-based OSM system in two CMV fleets. They found that the combination of OSM with driver feedback and coaching resulted in a 52.2% reduction in safety-related events per 10,000 miles. Furthermore, the most severe safety-related events were reduced by up to 59.1%. Additionally, results showed that the in-cab feedback light alone and/or coaching sessions that did not include videos were insufficient to significantly reduce the mean rate of safety-related events. Finally, the study found that drivers with the most severe safety-related events reaped the most benefits from the combination of data pulled from the OSM system with driver feedback and coaching.

Soccolich and Hickman[37] modeled the potential safety benefits of video-based OSM systems on all CMVs in the United States. They modeled the possible safety benefits of OSM systems by comparing the safety benefits found in Hickman and Hanowski[6] to a large national crash database, the General Estimates Systems (GES). This study found that a video-based OSM system paired with driver coaching had the potential to prevent an average of 727 fatal truck and bus crashes (20.5% of the total fatal crashes) and save 801 lives (20.0% of the total fatalities), reduce an estimated 25,000 truck and bus injury crashes (35.2% of the total injury crashes), and eliminate approximately 39,000 injuries (35.5% of the total injuries) each year.

Hickman and Geller[5] compared the effectiveness of two BBS self-management techniques with an OSM system in two groups of short-haul CMV drivers. One group of drivers was asked to record their intentions to reduce overspeeding and hard braking prior to the start of their shift (pre-behavior group). The other group of drivers was required to record their actual number of overspeeding incidents and hard stops after completing their shift (post-behavior group). Hickman and Geller[5] found that both groups reduced the mean percentage of time overspeeding and the mean frequency of hard braking. The pre-behavior group reduced their mean percentage of time overspeeding and mean frequency of hard brakes by 30.4% and 63.9%, respectively. The post-behavior group reduced their mean percentage of time overspeeding and mean frequency of hard braking by 19.3% and 49.4%, respectively.

Boodlal and Chiang[7] evaluated the safety benefits and fuel savings of telematics systems in 46 CMVs. They used an intervention that combined an accelerometer-based telematics device with instant driver feedback, post-drive manager coaching, and a reward system. Results showed that drivers reduced less severe safety-related events by 55% and more severe safety-related events by 60%. Additionally, the intervention reduced the percentage of miles driven with a speed greater than 65 mph for sleeper cab drivers (42% reduction) and day cab drivers (33% reduction). The percentage of miles driven with engine revolutions per minute (RPM) greater than 1,500 for sleep cab drivers (48% reduction) and day cab drivers (27% reduction) was reduced, and fuel economy improved for sleep cab drivers (5.4% reduction) and day cab drivers (9.3%).

Toledo, Musicant, and Lotan[8] found that an OSM system was effective in reducing risky behaviors and increasing safe behaviors after the initial installation. However, Toledo et al.[8] recognized that drivers only reduced their risky behaviors in the first month after the initial installation. After the first month, risky behavior remained stable. Although this pattern of behavior was not further explored, it is possible that heightened safety awareness may have

caused the initial decrease in risky behaviors. This highlights the need for continued back-office feedback and progressive goal setting by drivers and safety managers (i.e., the pairing of an OSM system with BBS techniques should result in sustained behavioral improvements).

Finally, Huang, Roetting, McDevitt, Melton, and Smith[9] evaluated truck drivers' opinions and perceptions of an OSM system that provided feedback on their driving behaviors. Huang et al.[9] found drivers' opinions of this technology were positive. Although drivers preferred feedback from their safety managers than from the OSM system, they indicated a desire for the OSM system to provide feedback on the safe behaviors they performed. This illustrates two critical points in a program using an OSM system: (1) the need for a back-office safety coaching component (as drivers preferred the face-to-face interaction with the safety manager), and (2) the program must provide feedback on safe (rather than only risky behaviors) driving behaviors or the process will be viewed negatively. The latter point stresses the need for a back-office coaching component as most of the OSM systems are trigger-based (e.g., hard braking, etc.) and cannot distinguish between safe and risky behaviors.

PROJECT OVERVIEW

The implementation of OSM technologies involves more than installing the technology in vehicles. It requires detailed planning and involvement from all levels within a fleet. Furthermore, criticism and resistance can often be expected from drivers when installing an OSM system. The purpose of this project is to provide a manual for CMV safety management personnel prior to implementing an OSM technology (or for carriers that have implemented an OSM system but are having problems achieving results). This manual is a practical, easy-to-understand reference guide for implementing an OSM program. It includes an overview of safety culture, a step-by-step guide for implementing a BBS program in conjunction with an OSM system, and a list of commercially available OSM systems.

CHAPTER 2. SAFETY CULTURE

Although OSM systems have the capability to record driver behavior, provide immediate feedback, and track driver behavior over time, these systems are unlikely to result in sustained behavioral improvement when implemented in the absence of a BBS program with a supportive safety culture. Thus, it is important to review the concepts of safety culture and strategies to improve safety culture prior to implementing an OSM program.

The following information is adapted from the North American Fatigue Management Program's (NAFMP) educational module on safety culture.[10] The lead author of the current report was responsible for authoring the safety culture module in the NAFMP. Although the NAFMP focuses on fatigue management, the information pertaining to safety culture is relevant to any safety program. Additionally, Short et al.[15] provide information on motor carrier best practices for developing a safety culture to reduce CMV crashes. These strategies are summarized below.

INTRODUCTION TO SAFETY CULTURE

Safety culture has remained a popular topic in the safety literature since the Chernobyl disaster in 1986;[11] however, the exact definition of safety culture has been widely debated.[12] Most people believe it is much easier to experience a company's safety culture than to actually define the concept. However, corporate safety culture can be thought of as a "lens" through which employees see how an organization feels about safety.[16,38] However, there are some common characteristics shared by most definitions, which include the shared beliefs, values, and attitudes toward safety across employees.[13-15] Although an assortment of variables have been correlated with injury rates, such as management support and commitment to safety,[39] communication,[40] risk perception,[41] physical and psychological demands,[39] satisfaction with the job,[41] and employee participation in decision making,[42] an organization's safety culture is ultimately reflected in the way in which safety is managed in the workplace. The safety management system (SMS) is the manner in which safety is handled in the workplace and how those policies and procedures are implemented in the workplace.[43] Thus, it is easy to see how the SMS and culture in an organization are closely related. Previously conducted research has shown a relationship between organizational factors and injury rates;[44] thus, an enhanced safety culture is a necessary tool in an effective OSM program. Figure 2 shows an example feedback loop for use by CMV management in a successful SMS.

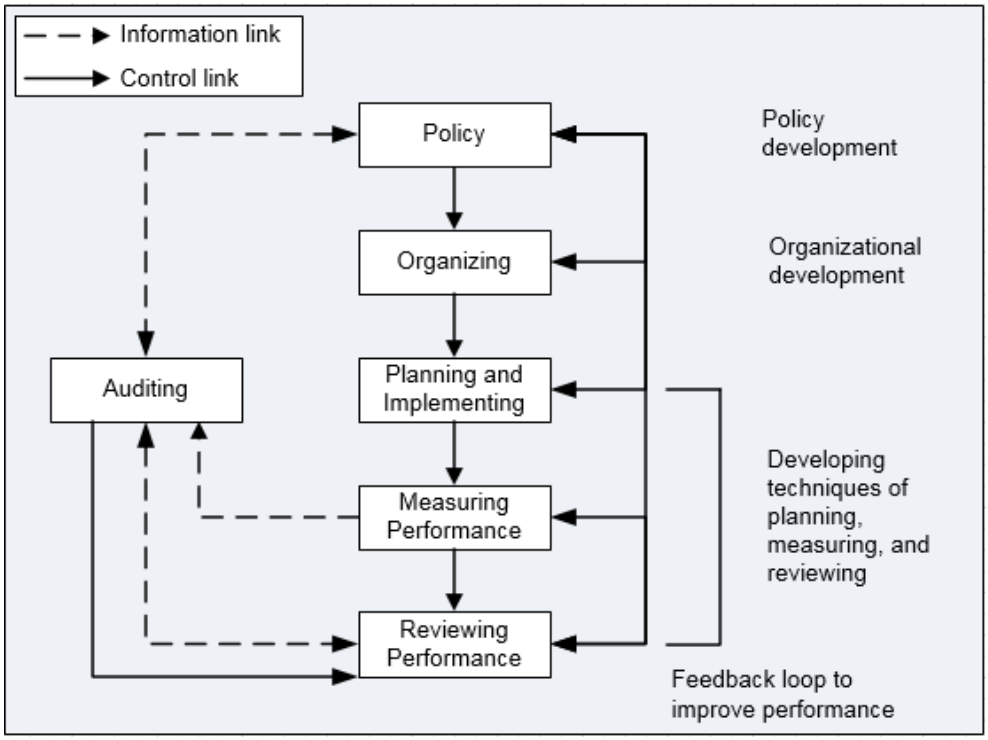

Figure 2. Key elements in a successful SMS (adapted from the Health and Safety Executive).[45]

Safety Triad and Safety Culture

There are three factors that influence safety, known as the safety triad.[16] Figure 3 provides an illustration of the safety triad and its influence on safety culture. The first factor that influences safety is the person. For example, each person has specific feelings, beliefs, attitudes, knowledge, skills, and abilities that influence how he or she will perform the required job. These personal factors influence the likelihood that an individual will perform each task safely. The second factor that influences safety is the environment. For example, equipment, tools, and management support may influence how a driver reacts in different situations. The person's behavior is the final factor that influences safety. This is the action taken by an individual in a given situation.

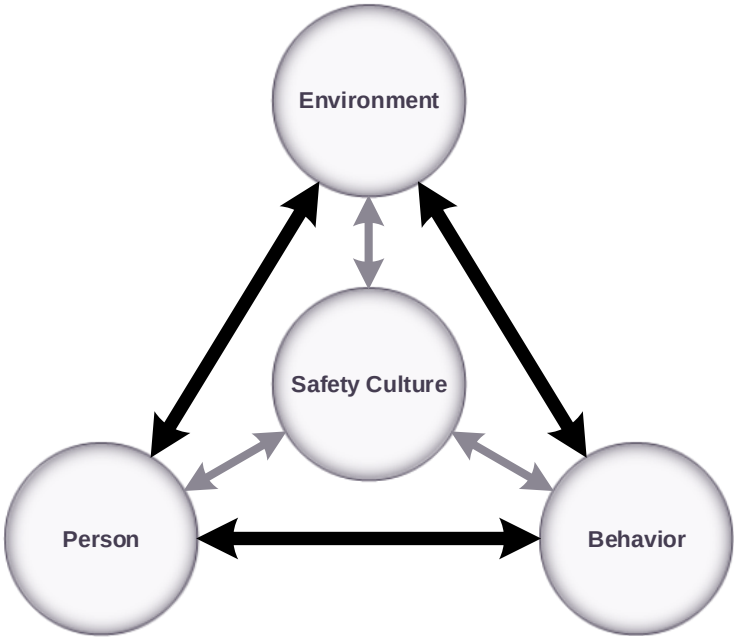

Figure 3. Safety triad (adapted from Geller).[16]

As shown in Figure 3, each factor in the safety triad influences the others. For example, a driver's personal belief about fatigue will influence the decision to drive when the driver is fatigued. Similarly, fatigue management tools provided by the organization will influence a driver's decision whether to drive while sleepy.

There is a strong link between a CMV fleet's safety culture and its crashes and injuries.[15,46-48] This link exists because safety culture influences the safety triad, and the factors in the safety triad directly influence the occurrence of crashes and injuries. Frequently, all three of the safety triad factors contribute to a risky decision that ultimately results in a crash. For example, a crash that resulted from a driver's decision to drive while fatigued may have resulted from a lack of knowledge about how to identify the signs of fatigue and pressure from the customer to arrive at a specific time. Successful safety cultures attempt to change these factors to reduce risky decisions, and therefore, reduce crashes and injuries. For example, organizations with successful safety cultures attempt to reduce the likelihood that a driver will drive while fatigued through fatigue education, implementing fatigue-monitoring technology, and by adjusting delivery schedules with customers. Figure 4 illustrates how successful safety cultures can influence safety performance.

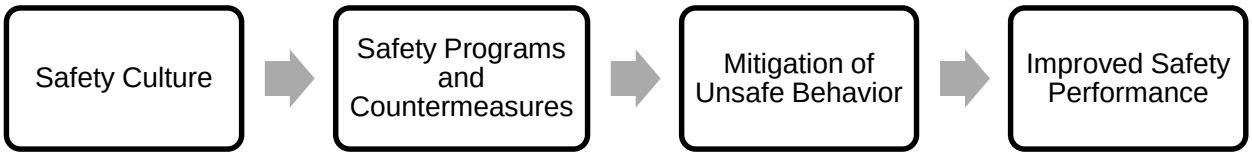

Figure 4. Linking safety culture and safety performance (adapted from Short et al.).[15]

OSM Systems and Safety Culture

A company's greatest asset is its drivers. Enhancing safety culture and implementing an effective OSM program will strengthen a fleet's greatest asset, and in turn, increase the bottom line. The consequences from drivers' risky behaviors can impact the bottom line through fines, property damage from driver error-related crashes, injuries, loss of customers, audits, reduced revenue, etc. Using the strategies outlined in this guide during OSM program implementation should help reduce drivers' risky behaviors, improve safety culture, and raise the fleet's bottom line.

There are many aspects of driver safety and an OSM program is only one. Thus, it is important to integrate the OSM program into existing driver improvement programs, and use the safety culture suggestions below to enhance safety culture. In other words, even though this guide specifically discusses OSM programs, all techniques and topics reviewed in this guide can be applied to all safety initiatives. Lastly, not all the suggestions included in this guide may be appropriate for your fleet. This guide provides examples for consideration when implementing an OSM program; you should know your personnel well enough to make a decision on what will work best with your organization.

CORPORATE RESPONSIBILITY AND ROLES IN OMS IMPLEMENTATION

All employees have a role in creating and sustaining a safety culture that discourages risky behaviors, regardless of their position in the organization. Management's largest contribution to safety culture comes through communication.[15] For example, management creates policies and procedures that either increase or decrease opportunities for safe performance. You are also responsible for providing feedback and rewarding safe behavior. Drivers have individual knowledge, skills, abilities, motivations, beliefs, and attitudes towards at-risk behaviors. Thus, you and your drivers share a responsibility to decrease risky driving.

Effective safety cultures move away from management control (i.e., top-down control) to driver involvement (bottom-up involvement).[16] Traditionally, most safety programs and initiatives were designed, developed, and implemented by carrier management. Drivers did not have much, if any, input into the process. This led to resentment, resistance to change, and ultimately, the safety program's failure. Creating an effective safety culture involves providing employees with the power and ability to create a safety program with your support. In terms of an OSM program, an effective safety culture should create bottom-up involvement in OSM implementation with top-down support.

Management's Commitment to Safety

Approval from management can motivate employees. Approval (or disapproval) may be in the form of pay, punishment, promotions, recognition, and management visibility. Thus, support and approval for the OSM program is critical.[15] Management not only needs to voice its commitment to the OSM program, it needs to show its commitment. Below are seven suggestions to help you emphasize your commitment to driver safety and the importance of the OSM program: (1) value safety equal to production, (2) maintain a high profile for safety, (3) personally attend safety meetings, (4) have one-on-one meetings with drivers that feature safe

driving as a topic, (5) include safety contracts in job descriptions, (6) be a safety leader, and (7) emphasize the need for continued communication about the OSM program.[16]

Value Safety Equal to Production

Clearly production drives most, if not all, organizational decisions. However, when drivers become injured, production decreases. Thus, it is equally important to keep drivers safe. In some cases, increased job performance, or productivity, may come at the expense of driver safety. For example, you may instruct drivers to complete a delivery despite a report that the truck is not operating properly or the driver reports the effects of fatigue. This instruction implies that production (e.g., completing the delivery) is more important than the safety of the driver (e.g., having the truck towed or instructions to take a break from driving).

Placing equal emphasis on safety and production should demonstrate your commitment to driver safety. It is likely you already measure and reward driver productivity. Thus, measuring and reinforcing safe driving should be treated similarly. Performance metrics of safe and risky driving should be created, and you should recognize and reinforce drivers who routinely perform safely. This strategy shows driver safety is valued and that driver safety should not be compromised to increase production.

Maintain a High Profile for Safety

Many organizations use the terms "value" and "priority" synonymously; however, both terms have different connotations. Although organizational values endure over time, priorities can be adjusted. Geller[16] (p. 46) provides the following story to illustrate the differences between a "value" and a "priority."

> Think about a typical workday morning. We all follow a prioritize agenda, often a standard routine, before traveling to work. Some people eat a healthy breakfast, read the morning newspaper, take a shower, and wash dishes. Others wake up early enough to go for a morning jog before work. Some grab a roll and a cup of coffee, and leave their home in disarray until they get back in the evening.
>
> In each of these scenarios the agenda – the priorities – are different. Yet, there is one common activity. It is not a priority but a basic value. Do you know what it is?
>
> One morning you wake up late. Perhaps your alarm clock failed. You have only 15 minutes to prepare for work. Your morning routine changed drastically. Priorities must be rearranged. You might skip breakfast, a shower, or a shave. Yet every morning your schedule still has one item in common. It is not a priority, capable of being dropped form a routine owing to time constraints or a new agenda. No, this particular morning activity represents a value which we have been taught as infants, and it is never compromised. Have you guessed it by now? Yes, this common link in everyone's morning routine, regardless of time constraints, is "getting dressed."

Increasing safe driving practices should be considered a value, just as "getting dressed" was in the example. No new deadlines, customers, technology, or schedule should compromise the safety of drivers. As mentioned previously, production decreases if a driver is injured or a truck is out of service from neglecting safe driving procedures.

When driver safety is a value, it is linked to all programs and tasks in your organization. Thus, driver safety should be discussed frequently in meetings. This will help illustrate how driver safety relates to all aspects of your fleet. Furthermore, these discussions remind others of the importance of driver safety. Finally, the more management discusses the importance of driver safety, the more likely drivers will begin to believe that you value safety.

Management Attendance at Safety Meetings

Most fleets hold regular safety meetings. Management's attendance at safety meetings reinforces your interest and commitment to reducing risky driving behaviors and increasing safe driving practices. This provides you the opportunity to change or align policies and procedures to encourage the continued reduction of risky behaviors. Safety meetings allow you to recognize and acknowledge drivers' efforts to reduce risky driving, provide feedback to groups of drivers on their progress towards safer driving, prompt safe driving practices, receive feedback from drivers concerning the positives and negatives of the OSM program, observe factors that contribute to the occurrence of risky driving, and have face-to-face communications with drivers.

One-on-One Meetings with Drivers Featuring Safe Driving

One-on-one meetings with drivers where safe driving is discussed are an excellent way to show your commitment to driver safety and the OSM program. These meetings allow drivers to see your enthusiasm for increasing driver safety and reinforce the position that safety is a value. These meetings can be informal or formal and can take place in an office, at terminal locations, in driver lounges, in hallways, etc. One-on-one meetings allow management to praise and recognize drivers who are actively involved in the OSM program. They allow you an opportunity to provide corrective driving-related feedback privately to drivers outside of a group setting. Furthermore, they allow you to hear criticisms of the OSM program directly from drivers, and give you opportunities to address driver concerns. Finally, these meetings provide an excellent opportunity to help drivers develop their own safe-driving-related goals.

Job Descriptions with Safety Contracts

Safety contracts detail the necessary information and expectations for safe driving. Including this information in the job description immediately educates drivers how to perform safely and raises expectations for safe driving. Safety contracts also reinforce the point that safety is valued, provide accountability for risky driving, and help drivers understand that safe driving is an essential job requirement. Items in the safety contract should outline the policy towards OSM systems, procedures for reporting risky driving, participation in safety meetings, providing feedback from OSM systems, and the development of safety-related goals.

Safety Leadership

When leaders perform safely and adhere to procedures outlined in the OSM program, others are more likely to perform safely and accept and adhere to these procedures. Often leaders are assumed to be managers. Although managers need to champion safe driving and the OSM program, other employees tend to naturally take a leadership role. Some drivers may naturally take a leadership role in the OSM program; however, the goal of a positive safety culture is to have all employees become safety leaders who take responsibility for their own safety and the safety of their coworkers. These safety leaders are a powerful tool to reach other drivers who are resistant to the changes. It is critical to identify the drivers that naturally take a safety leadership role and seek their involvement in the OSM program.

To identify drivers who are safety leaders, it is important to understand characteristics common to safety leaders. These individuals not only hold themselves accountable for safe driving, but they hold other drivers accountable as well. They strive to educate, not train, others on safe driving. Training involves instructing others *how* to drive safely. Education involves instructing others *why* to drive safely. Leaders also actively listen to criticism and concerns first prior to speaking. They do their best to understand the feedback being given before trying to respond. Safety leaders promote ownership of the OSM program by encouraging others to be involved by providing feedback and participation in meetings about the OSM system. They allow others to develop their own methods to perform safely without telling them they have to do it a specific way. Finally, they are confident that drivers will perform safely. They have no doubts that others will do their best to manage risky behaviors.

Communication about Safety Issues

Ongoing formal and informal communication regarding safety and the OSM program is critical in the development, implementation, and evaluation process. This communication will function to keep safety in the forefront and encourage acceptance of the program. Maintaining formal and informal channels of communication may help build trust in the OSM program and elicit valuable feedback concerning the implementation and effectiveness of the OSM program. This feedback will help to ensure all levels of the fleet are on the same page regarding the OSM program.

Additionally, drivers should be allowed to assist in developing the lines and methods of communication regarding the OSM program. This will help develop trust and provide drivers with a sense of ownership in the OSM program. Although not all drivers, or even the majority of drivers, will help develop communication strategies, some drivers will be interested. Allowing these drivers the opportunity to communicate will help gain trust in the program from other, more resistant drivers.

As mentioned above, you can greatly impact your safety culture through communication. In fleets with successful safety cultures, management does not use the term “accident.”[15] The term “accident” implies something could not have prevented the crash or injury and removes responsibility from the person involved in the unsafe behavior.[15] However, the majority of crashes are attributed to human errors and have been shown to be preventable.[3] Furthermore, the term “accident” may ultimately undermine your efforts in developing an effective safety

culture. More appropriate terms are crash, collision, near-crash, and injury. These terms more accurately describe the incident.

ENGAGING AND EMPOWERING STAFF AND GENERATING COMMITMENT TO THE OSM PROGRAM

Employee empowerment is often discussed in the business literature as a key to successful management initiatives and safety programs. However, there are a number of different meanings to the term "empowerment." Most management definitions of empowerment are centered on a shared responsibility,[49] authority and control,[50-52] and competence and impact.[53,54] Other definitions focus on providing organizational information and knowledge so employees can influence organizational performance and direction.[17] In terms of the OSM program, management can empower drivers by sharing information and knowledge about the OSM system that allow drivers to make decisions that directly influence the design, development, and implementation of the OSM program.

Research has shown that empowerment may impact cost control, organizational flexibility, product quality, and sales.[55,56] These objective outcomes may be the result of increased perceptions of personal control over the work environment,[57] increased job satisfaction and motivation,[58] organizational citizenship behaviors,[58] and recognition.[59] Furthermore, empowerment has been shown to be related to decreased turnover and absenteeism.[55]

Driver empowerment is important in developing and implementing a new safety initiative. Empowering drivers to make decisions related to the OSM program should increase acceptance of the program by building trust and increasing perceptions of program ownership. Providing drivers with information and knowledge related to the OSM program will help to develop a sense of shared responsibility for the safety of the workers themselves and their coworkers.

Empowerment and Resistance to Change

One of the most beneficial aspects of empowerment is that it counteracts the tendency of employees to resist new programs or change. New programs that are supported, developed, and/or owned by employees are more likely to succeed when compared to programs not supported or developed by the employees. Empowerment helps employees to develop the ownership, support, and trust of these new programs. OSM systems are traditionally disliked by many drivers. They believe the OSM system is designed and used to solely blame drivers for mistakes. As an OSM program is developed, empowered drivers will help make the OSM program more successful. Furthermore, empowered drivers will help to ease tensions and concerns from other drivers who are more reluctant to the change. Finally, empowerment should help to develop more accountability in the program.

Increasing Perceptions of Empowerment

There are three factors that influence an employee's sense of empowerment (Figure 5).[16] The first, self-efficacy, is a belief that "I can do it myself." This is developed by providing drivers with the knowledge, skills, and tools required to complete a task. For example, you must ensure that drivers have the required education to know why it is important to reduce risky driving behaviors and the skills required to drive safely.

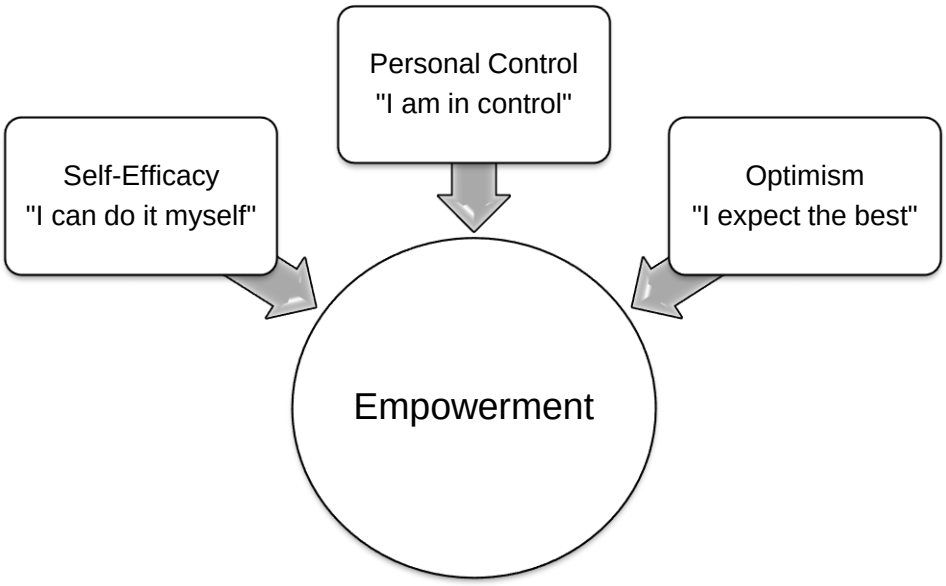

Figure 5. Three factors that influence empowerment (adapted from Geller).[16]

The second factor, personal control, is a belief that "I am in control." Personal control is developed by providing drivers with opportunities to directly influence decisions and outcomes in the CMV fleet. In terms of the OSM program, personal control can be developed by eliciting, addressing, and implementing specific feedback and suggestions regarding the development of the OSM program. Additionally, personal control can be provided through support and encouragement to participate in OSM-related meetings and the OSM steering committee. Finally, optimism is a personal belief that "I expect the best." You can help foster personal optimism in the OSM program by actively listening to program feedback and work to address and incorporate that feedback into the development and implementation of the OSM program.

Strategies for Increasing Empowerment

Listed below are several strategies for increasing an employee's sense of empowerment. These strategies are based on self-efficacy, personal control, and optimism.

1. **Trust that drivers will perform safely.** The first strategy for increasing drivers' perceptions of empowerment is to provide a sense of trust that they will perform well. You should develop drivers' beliefs that they can reduce risky driving behaviors and will be able to accomplish safety-related goals. This helps drivers increase their self-efficacy and optimism, or the belief they can do it themselves and do it well. As previously discussed, this strategy is also an important characteristic of a safety leader.

2. **Provide supportive feedback.** The second strategy for increasing perceptions of empowerment is to provide supportive feedback on safe driving behaviors. Feedback on what drivers are doing correctly provides encouragement to continue involvement in the OSM program and reinforces their efforts to reduce risky driving.

3. **Actively listen.** The third strategy is to actively listen to drivers' concerns and suggestions before offering rebuttals, advice, and/or feedback. Prior to offering your input, summarize what the driver said. This will demonstrate that you listened to the driver and it will ensure you have correctly captured his or her concerns. This will also demonstrate that you value drivers' opinions and desire their feedback. Drivers' working knowledge of the OSM program is critical in evaluating and critiquing the program for maximum effectiveness.

4. **Allow drivers to develop their own goals.** The fourth strategy is to allow drivers to develop their own safety-related goals with your support. When drivers develop their own goals instead of being assigned goals, they are more likely to strive to achieve them. Additionally, developing personal goals helps drivers become more self-directed instead of being other-directed. In other words, drivers will engage in safe behaviors because they feel it is the right thing to do rather than because you instructed them to do so. However, you should help drivers develop and achieve realistic goals. Additional information on the development of goals is described in Chapter 3.

5. **Allow drivers to develop their own strategies to achieve goals.** The final strategy to increase perceptions of empowerment is to allow drivers to develop their own strategies for increasing safe driving behaviors while reducing risky behaviors. Similar to the fourth strategy, allowing drivers to develop their own strategies should increase drivers' perceptions of self-efficacy and personal control.

BEST PRACTICES TO DEVELOP AND USE A SUCCESSFUL SAFETY CULTURE

Listed below are four steps required to develop a successful safety culture. These steps are adapted from Short et al.[15]

Step 1: Assess the Current State of Your Safety Culture

The first step involves evaluating what the safety culture currently is in your fleet. The following seven questions may help you understand the current state of safety culture.

1. **What is your fleet's safety culture?** You should review your organization's policies and procedures as they relate to safety. Do they intentionally or unintentionally influence your employees to engage in risky behaviors? How does this communication influence safety-related attitudes, beliefs, and values?
2. **What is your fleet's level of commitment to safety?** A good indication of your safety culture is to see how safely your employees perform outside of their jobs. In other words, how do your employees drive while off duty? Do they always wear their safety belts? Do they drive too fast in the parking lot? Additionally, determine what motivates your employees to engage in safe behaviors. Do they only perform safely when management is around? Do your employees actively offer safety suggestions to their coworkers? Do they actively participate in safety meetings?
3. **Are your safety programs (e.g., training and education, rewards and recognitions, etc.) effective in improving safety?** Do your drivers improve after

attending a training or education program? How frequently do your drivers engage in risky behaviors before training/education compared to after training/education? Similarly, are your reward and recognition programs effective in improving safety? Do your drivers' engage in safer behaviors after these programs?

4. **How is safe driving measured?** Measurement is essential to understand the performance of drivers. What safety-related data do you collect? What additional safety-related data can be collected? How are the data currently used, and what additional ways can you use these data to better understand the safety performance of drivers?
5. **Are your drivers empowered?** Drivers are critical to a CMV fleet's safety culture. Perceptions of empowerment can have a large impact on their ultimate safety performance and commitment to safety. What are your drivers' perceptions of self-efficacy, self-control, and optimism?
6. **What are the barriers to safety?** What internal factors are acting as barriers to maximum safety? Are there external factors that influence the level of driver safety?
7. **What are your safety communication strategies?** Communication is an important factor in developing a successful safety culture. How does your organization communicate about safety? Is this communication effective? Are additional communication strategies needed?

Step 2: Identify Areas for Improvement

The second step requires analyzing the data gathered in the first step. The following seven strategies are intended to help you develop a list of safety culture needs.

1. Based on your answers from Step 1, make a list of how your safety culture "should be" and list the areas that are in need of improvement. This will ultimately guide your strategies for improvement.
2. For each group of employees (e.g., management, drivers, dispatchers, maintenance, etc.), list specific safety-related programs, policies, and procedures that need improvement.
3. List the education, training, and reward/recognition programs that need improvement.
4. List the data and analysis needs that will help you better understand safe driving.
5. List the strategies that are needed to improve your drivers' perceptions of empowerment.
6. List new barriers to an improved safety culture.
7. List the communication strategies that need improvement or should be developed.

Step 3: Design Strategies to Improve your Safety Culture

The third step uses the information from Step 2 to develop specific solutions and strategies to improve your safety culture. The following information corresponds to the seven strategies listed in Step 2.

1. Develop high-level goals for the improvement of safety culture based on any discrepancies between how your safety culture "should be" and how it is currently. These goals will be achieved through solutions below.
2. Develop specific strategies to improve each group's commitment to safety. Strategies to increase drivers' commitment to safety may include showing that you value safety and are committed to the safety of drivers. Additional strategies may include increasing perceptions of empowerment, and appreciating and responding to drivers' feedback and concerns.
3. Redesign all training, education, and reward and recognition programs to address all areas in need of improvement. Safety should be emphasized in all programs. If a reward and recognition program is not currently offered, one may be developed. Reward and recognition programs should be based on safety data and goal achievement. Additionally, cash/monetary rewards should be minimized if used at all. Monetary rewards or large prizes motivate people, but focus their attention on winning instead of performing safely. In other words, the only reason to perform safely is to win the prize rather than to increase safe driving, which is the true purpose of the program. Instead, non-monetary (e.g., safety pin, coffee mug, team celebration/party, refreshments, t-shirt, safety sticker, thank you card, etc.) have been shown to be effective. Non-monetary rewards still motivate people, yet help to develop self-directed behavior. Furthermore, recognition for safe driving should be emphasized. Recognition can include listing the drivers' names in the local newspaper or an internal newsletter, posting a picture at the terminal, congratulations from management, a personalized letter from the chief executive officer, etc.
4. Design measures to identify the level of safe and risky driving. Examples are discussed in more depth in Chapter 3.
5. Develop strategies to increase perceptions of empowerment. See above for specific strategies to increase empowerment.
6. A designated safety department or personnel should identify methods to remove any barriers that are negatively effecting safety culture.
7. Develop communication strategies that emphasize the value of safety and provide safety-related feedback regularly. See above for additional information on effective communication.

Step 4: Implementation of Improvement Strategies

After solutions have been identified, you should implement the strategies to improve your safety culture. During implementation, it is important to seek feedback and suggestions from all groups

of employees. This feedback should be used to evaluate the effectiveness of the improvements and add or redesign strategies that are not effective.

CHAPTER 3. STEP-BY-STEP GUIDE TO IMPLEMENTING OSM SYSTEMS

This chapter provides a step-by-step guide to develop, implement, and evaluate the OSM program, including the following steps:

- Step 1: Develop a positive safety culture.
- Step 2: Assemble a steering committee.
- Step 3: Define roles and responsibilities in the OSM program and develop a policy for the OSM program.
- Step 4: Benchmark risky driving.
- Step 5: Evaluate OSM technologies.
- Step 6: Develop performance measures.
- Step 7: Develop an implementation timeline.
- Step 8: Develop accountability.
- Step 9: Develop awareness, education, and training.
- Step 10: Implement the OSM program.
- Step 11: Monitor and evaluate the OSM program.

Figure 6 provides an illustrative flowchart of the processes involved in developing and implementing an OSM program.

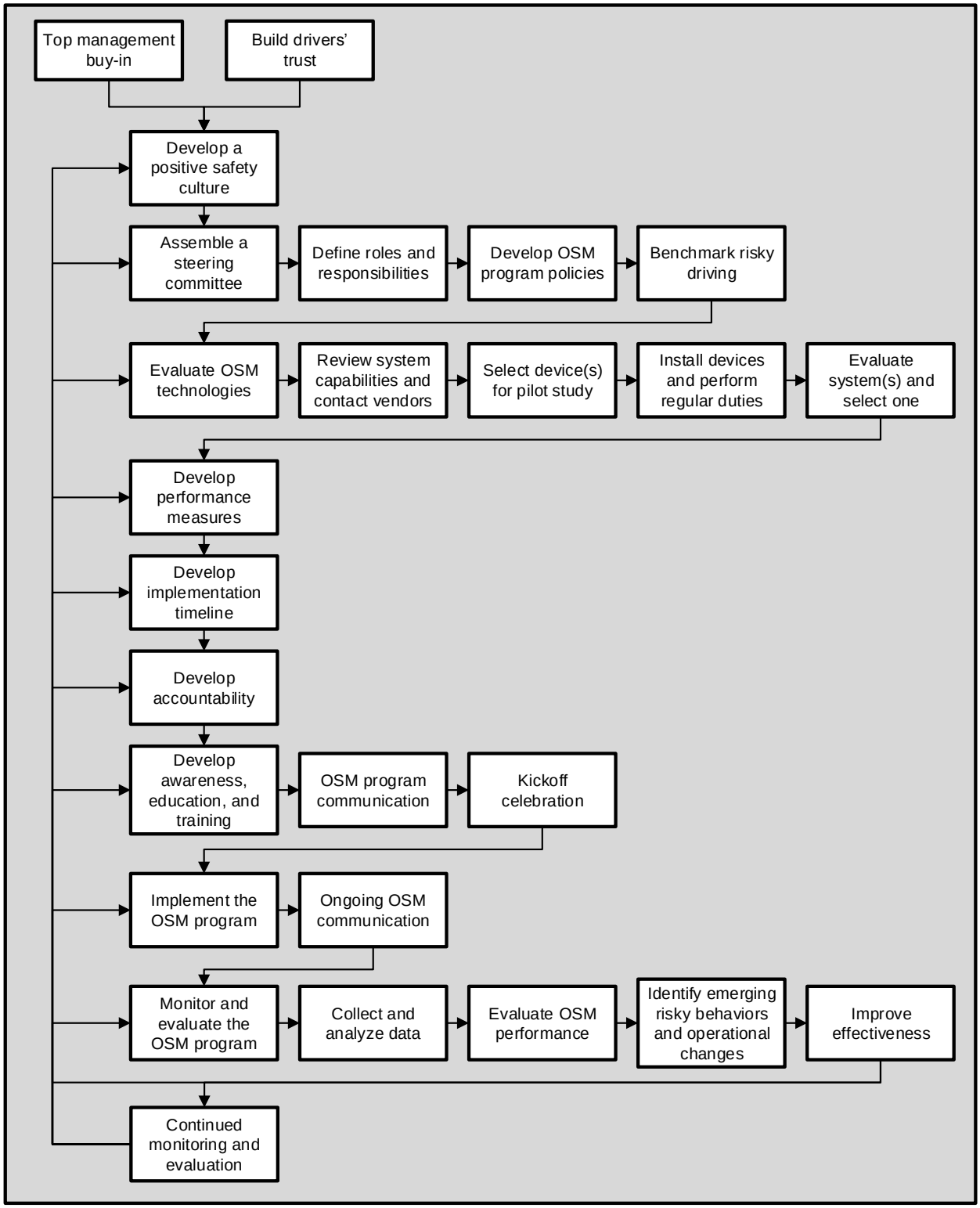

Figure 6. OSM program implementation flowchart.

The following information was adapted from Camden et al.[21] and Module 2 in the NAFMP.[10] Camden et al.[21] and Module 2 in the NAFMP[10] provide guidance for corporate culture change

and the implementation of a fatigue management program. The current guide revised these steps to focus on the development and implementation of an OSM program.

STEP 1: DEVELOP A POSITIVE SAFETY CULTURE

Top Management "Buy-in"

Rarely does a new organizational initiative or program succeed without top management's support or "buy-in." Typically, the programs supported and pushed by management are those programs that are carried out. Similarly, programs that are not fully supported by top management often have short life spans.

During periods of organizational change or during the initiation of new programs, employees often look to their supervisors and top management for direction and guidance. Thus, it is critical for management to be fully committed to all new programs. With the OSM program, you must show enthusiasm and commitment to the success of the program. Although top management's support, commitment, and involvement do not guarantee the success of the OSM program, they are the essential foundation on which the OSM program will be built.

Your "buy-in" to the OSM program may be created through ongoing, supportive, face-to-face interactions with the employees who are the most affected by the OSM program (i.e., drivers). These interactions need to be sincere, and lip service should be avoided. These interactions are an opportunity to provide positive information about OSM systems, positive feedback, praise, and recognition for safe driving.

As the OSM program is implemented, you need to attend and participate in all meetings where the OSM program is discussed. In these meetings, you should emphasize the benefits of OSM systems, expectations for success, and progress towards organizational-wide safety goals. Furthermore, attendance at these meetings helps you to be fully involved in the development and implementation of the OSM program.

Build Trust

Demonstrating management's "buy-in" helps to build drivers' trust in the OSM program and management. Building trust is one of the most powerful techniques to ease resistance to the OSM program. Strategies to create a positive safety culture were discussed in-depth above, but they are summarized below. In addition to visibly showing management "buy-in," the following techniques should be used to help develop driver trust in the OSM program.

- **Encourage involvement from all.** All employees, especially drivers, should be invited and encouraged to be involved in the development of the OSM program. This will increase drivers' perceptions of ownership in the OSM program. As discussed above, increasing the perception of ownership is a powerful technique that decreases drivers' resistance to change. Additionally, this will allow concerns from different levels in the organization to be considered in the development of the OSM program.

- **Seek feedback.** You should seek specific feedback from drivers and others that will be affected by the OSM program. This feedback should include information about drivers' concerns, perceived benefits, challenges, etc., about the OSM program.
- **Actively listen.** You should actively listen to all feedback and concerns. You should carefully consider all the feedback, and address and incorporate themes from the feedback into the development of the OSM program.
- **Provide opportunities for choice.** Create as many opportunities as possible for drivers to make choices and decisions during the development of the OSM program. Opportunities for choices include, but are not limited to, participation in the OSM program steering committee, input on which OSM system best suits the needs of the organization, ideas for the incentive and reward structure, input on which measures should be used to assess OSM program effectiveness and goal achievement, methods to provide feedback, and training and education required for a better understanding of the OSM program.
- **Demonstrate that safety is a value.** As discussed in Chapter 3, you need to consider safety a value, not a priority. Thus, safe driving needs to be considered a value that is related to all other functions, programs, and initiatives in the organization.
- **Commit to reducing management's own risky driving.** In addition to the drivers, you should commit to reducing your own risky driving behaviors. This helps to model appropriate behavior and visibly show that you believe in the importance of the program. You could even agree to install an OSM system on your vehicle and share your data and progress with drivers.

STEP 2: ASSEMBLE A STEERING COMMITTEE

After a positive safety culture has been developed, you should identify a team to champion the OSM program. One means to champion the OSM program is to assemble a steering committee. The steering committee will be responsible for the development of the OSM program, oversight of the program once it is implemented, necessary support for drivers, and the evaluation of the program once it has been implemented. Additionally, the steering committee will be responsible for the documentation process that explains and records the following areas in the OSM program:

- Policies and objectives;
- Processes and procedures;
- Each party's accountability, responsibility, and authority in the OSM program;
- A description of the education and training programs, training requirements, and attendance records in the OSM program; and
- Program data, findings, and recommendations.

Although there is no standard size or structure for the steering committee, it is recommended that all levels of the organization be represented, especially those employees most affected by the OSM program (i.e., drivers). A driver advisory council on the steering committee helps demonstrate the importance of driver input and carrier "buy-in." It is also important to include

employees with varying levels of experience on the steering committee. The steering committee should represent the general population of the fleet. In small fleets, one person may represent an entire group of employees (e.g., one driver to represent all drivers). In very small fleets, the steering committee could be a function of the safety personnel (if possible). In this case, the safety personnel would be charged with all documentation, design, and implementation of the OSM program. The steering committee in small fleets could include one upper level manager, one mid-level or lower-level manager, a maintenance manager, and one or two drivers.

Appendix A provides an example document describing the terms and responsibilities of a steering committee (adapted from the Department of Premier and Cabinet, Tasmania).[60] This document is intended only as a reference, and some of the terms and responsibilities may not apply to all organizations.

Develop a Safety Vision

After the terms and responsibilities of the steering committee are developed, the next task of the steering committee is to develop a safety vision. The steering committee's vision will guide the entire process of development, implementation, and evaluation. It is critical to develop the vision first, and then use it in all phases of developing the OSM program. In developing the safety vision, it may be important to answer the following questions:

1. What is the purpose of the OSM program?
2. How should the OSM program affect the future of this organization?
3. What is the ideal outcome of the OSM program?
4. What is the current state of risky driving within the organization?
5. What steps are needed for the organization to reach goals related to risky driving?

STEP 3: DEFINE ROLES AND RESPONSIBILITIES IN THE OSM PROGRAM AND CREATE A POLICY FOR THE OSM PROGRAM

An essential element of the OSM program is a shared responsibility for driver safety. To develop accountability in the OSM program, management and driver responsibilities need to be clearly defined in a policy statement regarding the OSM program (discussed below). Management is fundamentally responsible for controlling operational factors associated with driver safety. Management's responsibilities in the OSM program include, but are not limited to:

- Ensuring that the OSM program is implemented;
- Ensuring that adequate resources are available for the OSM program;
- Providing policies that support safe driving practices;
- Creating a safety culture that promotes open and honest feedback regarding risky driving behaviors;
- Providing training on how the OSM system operates to all drivers;
- Regularly reviewing safety-related events identified by the OSM system;
- Providing timely feedback to drivers regarding the identified safety-related events;
- Providing constructive driver coaching sessions to reduce risky driving behaviors;
- Assisting drivers in goals that are specific, motivational, achievable, relevant, and trackable (SMART; Figure 7);[16]

- Providing recognition/rewards for goal achievement;
- Regularly communicating the effectiveness of the OSM program with drivers; and
- Demonstrating a commitment to continuous improvement of the OSM program.

Drivers have a personal responsibility to drive safely. Driver responsibilities in the OSM program include:

- Choosing to use safe driving behaviors;
- Participating in OSM program training and education;
- Participating in driver coaching sessions;
- Developing individualized SMART goals;
- Complying with the policies in the OSM program; and
- Communicating with management any concerns they have about the OSM program.

Develop Policies for the OSM Program

The policies in the OSM program should clearly define all elements that support the program. The policy should be developed by the steering committee with input from all levels of the organization, especially those most affected by the OSM program (i.e., drivers). Developing policies for the OSM program with the help of drivers will illustrate your concern for driver safety and demonstrate trust and support in the drivers' perceptions and opinions. The policies in the OSM program should include or address the following:[61]

- **All elements in the OSM program**: The policies should reflect all driver safety systems and plans.
- **Scope of the OSM program**: The policies should clearly identify those operations where the OSM program applies. As the OSM program is implemented and evaluated, it may be important to add or remove certain policies that were missing or unsuccessful. This should be considered part of the normal evolution of the OSM program.
- **Shared responsibility between management, drivers, maintenance, and other relevant personnel involved in the OSM program**: As discussed above, drivers and management share a responsibility for safety. Drivers are personally responsible for performing the job safely to the best of their ability. Additionally, drivers are responsible for cooperating with all data collection and driver coaching efforts. However, drivers' willingness to cooperate in the OSM program is largely dependent upon management. Thus, you are responsible for supporting and participating in the OSM program, providing support to drivers, acknowledging drivers' efforts to reduce risky driving, providing feedback and driver coaching sessions, and developing a positive safety culture to support a successful OSM program.
- **OSM program safety objective definitions**: Safety objectives state the purpose of the OSM program and what the OSM program is expected to achieve. The safety objectives need to be based on SMART goals (Figure 7).[16] Example measures that may be useful for safety objectives are described below.

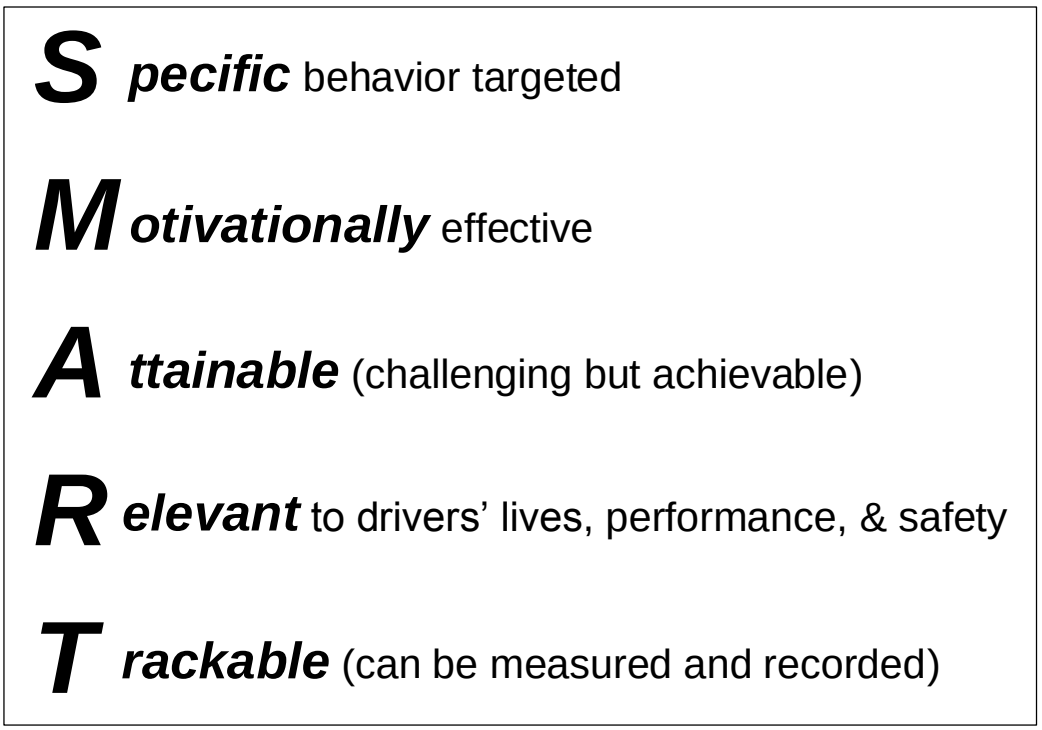

Figure 7. SMART goals (adapted from Geller).[16]

Objectives should be:

- Written clearly and signed by the executive accountable for the OSM program;
- Be clearly communicated to all relevant personnel in the organization;
- Emphasize your commitment to effective communication and continuous OSM program improvement; and
- Require regular evaluation of the OSM program to ensure continued effectiveness.

Appendix B provides two examples of a policy statement adapted from Camden et al.[21] and the International Civil Aviation Organization.[61]

STEP 4: BENCHMARK RISKY DRIVING

Before selecting an OSM system, it is important to evaluate the current state of risky driving in your organization. This will direct the search for the best-suited OSM system. Below is a list of issues to consider that may help guide the evaluation of an appropriate OSM system.

- What does your organization currently do to prevent risky driving?
- What are the three most frequently seen risky behaviors in your organization?
- Are there other risky behaviors that drivers perform?
- Which risky driving behaviors result in the most severe crashes?
- How does the frequency of these behaviors compare to the industry as a whole?
- How do you respond to a driver who has engaged in risky driving behavior?

- What environmental characteristics typically occur directly before drivers engage in risky behavior?
- Are there any factors reinforcing drivers' use of risky behaviors?

Answering these questions will help determine which risky behaviors to target in the OSM program. Additionally, they will help determine if any changes are needed to reinforce safe driving.

STEP 5: EVALUATE CURRENTLY AVAILABLE OSM DEVICES AND SELECT ONE FOR YOUR OSM PROGRAM

Once the steering committee has developed goals and benchmarked the current state of risky driving, an OSM system can be selected. Trimble and Bowman[62] compiled a guide of aftermarket telematics services. This guide reviewed the available telematics systems and analyzed the usefulness of each system to inform purchasing decisions. Although Trimble and Bowman[62] included some information on OSM systems, this information was limited and did not identify OSM vendors, per se. The current project used the list compiled in Trimble and Bowman[62] as a guide to identify telematics providers with OSM capabilities.

To be included in this list, an OSM system must provide two functionalities. First, the OSM system must target at least one safety-related behavior. Safety-related behaviors include speeding, hard braking, rapid acceleration, quick cornering, seat belt use, distraction, stop sign/red light violations, following distance, lane position, headlight use at night, etc. Second, the OSM device must include a back-office component where a safety manager or other fleet personnel can track safe and risky driving performance.

The list of currently available OSM vendors is located in Appendix C. This list includes the name of the OSM vendor, contact information, type of OSM system (i.e., telematics-based versus video-based), reporting and alerting functionality, and training and support (if offered).

As can be seen in Appendix C, there are many vendors that provide OSM systems. The specifications and abilities of these devices differ greatly. Thus, it is critical to carefully select the OSM system that best suits the needs of your organization. To accomplish this task, a pilot program should be developed. The purpose of this pilot test is to ensure that the selected OSM system meets the needs of your organization before full-scale implementation. Described below are seven recommendations for selecting an OSM system for a pilot program, setting up the pilot program, evaluating the performance of the OSM system, and determining if the OSM system (or which one if evaluating several) is ready for full-scale implementation.

Review Capabilities of Currently Available OSM Devices

The first step in the pilot program is to review currently available OSM devices. A list of OSM vendors can be found in Appendix C. Listed below are several questions that may be helpful in your review of OSM systems.

- What behaviors can the OSM system track? Not all systems have the capabilities to track all risky and safe behaviors. It is important to review the systems that can measure the behaviors identified during the benchmarking process.
- What is the cost of the OSM system? Cost is likely a factor in what OSM system is selected. It may be helpful to eliminate the OSM systems that are outside your budget.
- Is the software for the OSM system compatible with your current back-office software? Many OSM vendors offer software that can be easily integrated into an organization's back-office programs.
- Is a video-based OSM system or accelerometer-based OSM device preferred? As mentioned above, some OSM systems include cameras that record the driver and the forward roadway. If both types of devices may be of interest, you should consider a pilot test that compares both types of systems.

Contact OSM Vendors

The next step is to contact the OSM vendors identified in the previous step. Several questions that may be important to ask are listed below.

- What technical support is offered by the OSM vendor? Some vendors offer 24-hour customer service and on-site installation and maintenance. Additionally, some vendors may be more flexible in meeting the unique needs of your organization. It is also important to consider the geographic location of the OSM vendor. There may be language or culture barriers that impede technical support. Finally, some vendors offer training to back-office personnel to maximize the effectiveness of the OSM system.
- Does the OSM vendor offer price reductions based on bulk orders? If your organization is large, price reductions may be available for bulk orders.
- What is the life span of the OSM system? This is important to determine the return on investment.
- Does the software in the OSM system have the ability to be customized to fit the needs of your organization? It may be possible to customize the software or device to track a specific behavior. Additionally, your organization may want to adjust the preset thresholds to identify risky and safe behaviors.

Select the Device(s) for the Pilot Study

After discussing the needs of your organization with a number of vendors, you should select one or two OSM systems to pilot test. A minimum of two devices should be ordered (from each vendor if multiple vendors are selected); however, additional devices may be helpful. Multiple devices will allow sufficient information to evaluate the performance of the OSM system.

Install OSM Devices

It is important to carefully select the drivers that will participate in the pilot test. The purpose of the pilot test is to gather as much data as necessary to evaluate the OSM systems. The purpose of this pilot test should not be geared towards changing driver behavior, but getting a feel for how

the device works and whether it will collect the necessary data. Thus, experienced, well-respected drivers may be the most appropriate to test the OSM systems. These may be the same drivers that are involved in the steering committee. The selected drivers need to be open-minded to OSM systems and willing to provide honest feedback on the performance and implementation of the OSM system. Once the drivers are selected, it is important to discuss and train the drivers on the purpose of the pilot test and the functionality of the OSM system. Again, the goal of the pilot test is to evaluate the functionality of the system and how it fits within your organization.

Perform Regular Activities and Collect Data

Allow drivers to perform their regular duties for a minimum of one month (a longer trial period will provide more information) while the OSM system records their driving performance. You should review the OSM data and provide individual driver coaching on the identified safe and risky behaviors. Although the pilot test should focus on the functionality of the OSM system, it should also test the implementation and procedures for driver feedback and coaching. During this phase, it is important for you to regularly communicate with the participating drivers about any problems with or concerns about the OSM program.

Evaluate the Performance of the OSM System(s)

After drivers have used the OSM systems for the trial period, the steering committee should evaluate how well each device performed. To assist in the evaluation, the following questions should be considered.

- What are the drivers' final evaluations of the system? The drivers should provide information about what they liked and disliked about the OSM systems. The drivers may provide information about what worked well, the amount of information the OSM system provided, the effectiveness of driver coaching, and suggestions regarding whether or not a particular OSM system should be implemented fleet wide.
- Did the OSM system have the potential to reduce risky behaviors and/or increase safe behaviors? The steering committee should review performance data from the OSM system to evaluate the ability of the device to target behaviors for change.
- How was your experience with the OSM vendor? Did the vendor meet your expectations?
- Was the software easily integrated into the existing back-office software?
- Are there additional behaviors that should be tracked?
- Are additional services or tools needed that are provided with a different OSM system?
- How was the implementation process? Are additional steps necessary? Was adequate training provided? Participating drivers should provide feedback on their experiences in the implementation process. They should provide suggestions that may help ease the implementation process, and provide recommendations to ease tensions of other drivers during implementation.

Select an OSM System for Fleet-Wide Implementation

Based on the evaluation above, your organization should select a device that meets the needs of drivers and management. If the evaluation showed that the device(s) did not meet expectations, repeat the pilot test with another device.

STEP 6: DEVELOP PERFORMANCE MEASURES

As with any program, the key question is, "Is the program working?" An OSM program is no different. To answer this question, the steering committee needs to identify which measures will indicate success and develop accountability for risky driving. If behaviors are not measured and recorded, it is impossible to know whether the OSM program changed drivers' risky and safe behaviors. Additionally, measurement allows you to track driving behaviors so that rewards and recognition can be provided when drivers reach predefined goals. Measurement can also identify drivers who are having difficulty in reaching their goals and are thus in need of additional help and coaching. As a last resort, any disciplinary actions should be based on the same measures.

There are two types of performance measures, process measures and outcome measures that can be used to evaluate the success of your OSM program. Process measures are performance-based measures that focus on the behavior, such as rapid braking. Outcome measures are result-focused and emphasize the result or a goal, such as zero preventable crashes. In other words, outcome measures only focus on the end result of behavior and typically only provide an indication of risky behavior after a resulting injury or crash.

Process Measures

Process measures should be the primary focus when delivering feedback and in developing recognition and rewards for goal achievement. This is because the behaviors targeted by process measures are directly in control of the driver.[16] When effectiveness or success is measured using outcome measures, drivers' motivation to achieve goals will be reduced. Additionally, only using outcome measures will lead to underreporting risky driving behavior and undermines management's commitment to safety.[16] Research has shown that process-based programs can increase safety behaviors in transportation.[63] The use of rewards and recognition tied to process-based measures has been found to increase safety belt use,[64-66] turn signal use,[67] decrease hard braking,[5] and decrease the frequency of speeding.[5] Other research on process-based incentive programs has shown increases in targeted and non-targeted safety-related behaviors.[67-73] For example, in Ludwig and Geller,[70] researchers assessed the number of complete stops drivers made at an intersection for two groups of drivers (one group was assigned a goal to increase complete stops, and the other group participated in the goal-setting process to increase complete stops). Ludwig and Geller[70] found that drivers who participated in the goal-setting process increased the number of complete stops and also increased the likelihood that they used a safety belt and turn signal (whereas the assigned goal was only effective in increasing the targeted behavior, complete stops).

Some example process measures that may be useful in the OSM program include:

- Number of hard braking events;

- Number of rapid accelerations;
- Number of hard cornering events;
- Number of speeding events;
- Number of severe alerts per week;
- Number of coaching sessions;
- Number of drivers who earned recognition;
- Percentage of time following mobile phone policy (if there is one);
- Percentage of drivers that attended safety meetings each month;
- Percentage of time with a safe following distance;
- Percentage of driving time a safety belt was worn.

Outcome Measures

As mentioned above, outcome measures focus on the result or outcome of the occurrence of behavior(s). Many of these measures are not in the full control of the driver. For example, crashes may not be the result of the driver's behaviors. There may have been a number of other environmental factors that influenced the crash. In terms of behavior change interventions, such as an OSM program, it may be best to use process-based measures and outcome-based measures for different purposes. Outcome measures are best used by management to evaluate the overall effectiveness of the OSM program. Some example outcome measures include:

- Number of preventable crashes;
- Number of crash-free miles;
- Number of DOT-reportable crashes;
- Number of injuries;
- Drivers' perceived job satisfaction measured via a questionnaire.

STEP 7: DEVELOP AN IMPLEMENTATION TIMELINE

Timely implementation is an important factor when creating driver "buy-in" with the OSM program. Additionally, a systematic timeline for OSM system installation is critical to ensure a smooth transition. An implementation timeline should be developed (and adhered to) that ensures that control measures and mitigation strategies are established as quickly as possible. Not only will this confirm that actions are promptly taken to mitigate risky driving, but it will also illustrate the commitment of management to the OSM program. The steering committee should closely monitor the activities in the OSM program to ensure the timeline is followed.

STEP 8: DEVELOP ACCOUNTABILITY

When it comes to risky driving, it is important that drivers transition from other-directed responsibility and accountability to self-directed responsibility. To achieve self-directed responsibility and accountability, the following strategies have been successful.

- You should recognize and acknowledge drivers' participation in the development of the OSM program. This will increase drivers' "buy-in" to the program and will help reduce

resistance. It will also allow drivers to take ownership of the program and reduce uneasiness with the OSM system.

- Only hold drivers accountable for those things they can control directly. For example, you should not hold drivers accountable for fatigued-related driving if the driver's schedule or dispatch contributed to the driver becoming fatigued. This is why it is important to develop process-based measures in Step 6. Process-based measures focus on behaviors that remain under the control of the driver.
- Help drivers set goals that are SMART (see Figure 7).[16] These goals identify a relevant behavior that needs improvement and the level of performance that is needed to achieve the goal. Additionally, goals need to motivate drivers to change their behavior and should be tied to specific rewards, such as praise and recognition for safe driving. Finally, goals must be perceived as achievable. When setting goals, it is best to set small, yet, challenging goals.
- Provide drivers with feedback on their progression toward goal accomplishment, offer suggestions for improvement, and praise drivers for their successes.
- Conduct "fact-finding" investigations, not "fault-finding" investigations. In other words, you should not simply investigate an incident to find fault. Investigate incidents to identify the facts that took place before and after the incident, and then offer suggestions to ensure those mistakes and hazards do not occur again.
- Design performance measures based on specific behaviors (i.e., process measures) and not the outcome or result of a number of behaviors (outcome measures). The differences between these measures are discussed above.

STEP 9: DEVELOP AWARENESS, EDUCATION, AND TRAINING

All employees need to be informed about the OSM program. This communication should consider the various needs of employees in your fleet, including:

- Various reading levels;
- Difficulty reading English;
- Differences between daytime and nighttime shift workers receiving communications; and
- Long-haul versus short-haul drivers receiving communication.

Based on the various needs in your fleet, different communication methods may be required. A number of communication types can be used, including, but not limited to:

- Electronic communications (e.g., email and websites);
- Companywide newsletters;
- Bulletins;
- Fliers;
- Safety seminars;
- One-on-one, face-to-face meetings; and
- Group meetings.

OSM Program Kickoff

A major responsibility of the steering committee is to ensure all employees know the principles, policies, and procedures of the OSM program. Making employees aware of the reasons for developing and implementing the OSM program should help reduce resistance as employees will learn why it is important to reduce risky driving and increase safe driving. Additionally, drivers should be educated and trained on the functionality of the selected OSM system. Drivers need to understand what behaviors will be tracked and reported by the OSM system and what the alerts from the OSM system indicate.

Once all employees understand the importance and background of the OSM program, a kick-off meeting and celebration should be held at the onset of the implementation of the OSM program. This will develop trust in the program by showing support and participation of management personnel.

STEP 10: IMPLEMENT THE OSM PROGRAM

After drivers' concerns have been addressed, education has been provided, and a kick-off celebration has been held, the OSM program is ready to be implemented. According to the implementation timeline developed in Step 7, the OSM systems should be installed, drivers' performance data should be collected, all safety-related events identified by the OSM system should be reviewed, and feedback and driver coaching sessions should be held.

Ongoing OSM Program Communication

Your continued support for the OSM program helps sustain enthusiasm and participation in the program. To ensure employees know you will continuously support the OSM program, you should maintain formal and informal communication channels, remain active in safety-related discussions, and actively listen to and address all program-related feedback.

Your attendance at safety meetings will demonstrate your commitment to the OSM program. Such meetings provide you with opportunities to change or align policies and procedures to encourage safe driving. These meetings allow you to recognize and acknowledge drivers' safety efforts, provide feedback to drivers about their progress, encourage safe driving behaviors, receive feedback from drivers about mitigation strategies that are not working, gather data about factors that contribute to drivers' decisions to engage in risky driving, and hold face-to-face communications with drivers.

Face-to-face meetings with drivers in which safety is discussed provide a way for your organization to show its continued commitment to safety management. These meetings allow drivers to observe your enthusiasm for increasing safety and reinforce the position that driver safety is valued in the fleet. These meetings can be informal or formal and can be held in an office, terminal location, driver lounge, or hallway. Face-to-face meetings provide an opportunity for you to praise and recognize drivers who are actively involved in the OSM program. These meetings also allow you to provide private feedback to drivers outside of a group setting. Furthermore, such meetings allow you to hear criticisms of the OSM program directly from drivers and provide an opportunity to address drivers' concerns. Finally, these meetings are an ideal method to help drivers develop their own safety-related goals. No matter the type of

communication strategy used, the safety-related messages conveyed during these meetings need to be clearly stated, timely, and based on credible evidence (e.g., data gathered by the OSM systems).

STEP 11: MONITOR AND EVALUATE THE OSM PROGRAM

Once the OSM program has been fully implemented, it is critical to regularly review OSM data to evaluate the effectiveness of the program. The OSM program should be reviewed when:

- Operational changes are made;
- Staffing patterns or scheduling changes are made;
- Data from the OSM system suggest that risky driving behaviors are not being reduced; and
- New technologies, tasks, or equipment are added.

During a review of the OSM program, the following questions should be asked:

- Are feedback, coaching, and countermeasures working as intended?
- Was the OSM program implemented as expected?
- Have new risky driving behaviors developed?
- How do the number of crashes, near crashes, injuries, violations, and other data (e.g., absenteeism) compare to the time before the OSM program was implemented?

Evaluation of the OSM program includes five steps. Figure 8 provides a summary of the evaluation process (adapted from Camden et al.[21] and the International Civil Aviation Organization).[61]

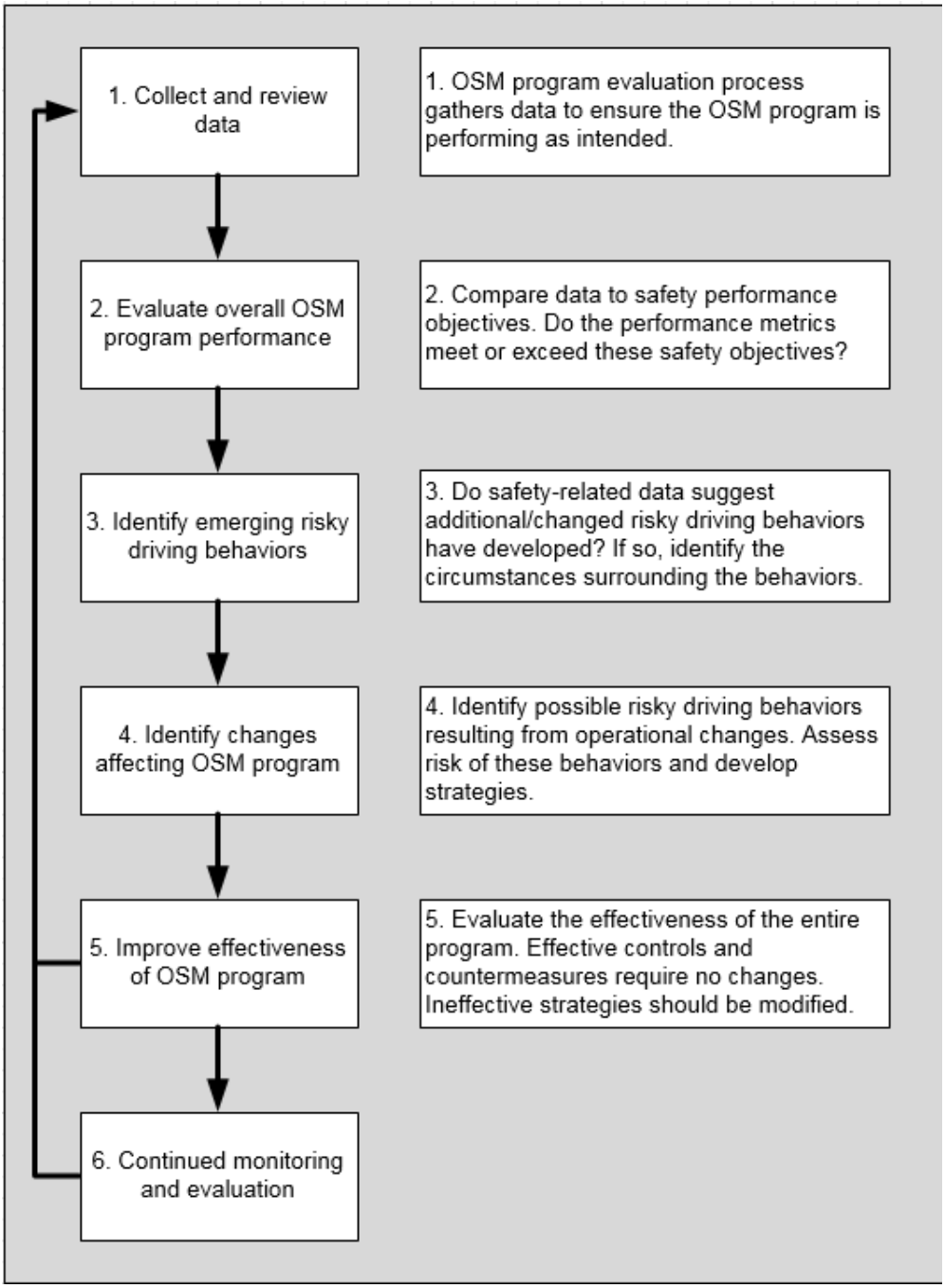

Figure 8. Process for OSM program evaluation (adapted from Camden et al.[21] and ICAO).[61]

Step 1: Collect and Review Data

The first step in the evaluation process is to review all the data gathered by the OSM systems and from investigations of crashes and near-crashes to analyze the overall effectiveness of the OSM program. Example performance measures can be found in Step 6 above.

Step 2: Evaluate OSM Program Performance

The purpose of this step is analyze the overall effectiveness of the OSM program. To accomplish this task, the data gathered in Step 1 of the evaluation process should be compared to the safety performance objectives defined in the OSM program. Trends indicating gradual decreases in risky driving behaviors should provide insight into the effectiveness of the OSM program. However, dramatic decreases of risky behaviors should not be expected immediately after implementation. Behavior change requires time, and patience is needed when determining the overall effectiveness of the OSM program. Figure 9 below shows a hypothetical example graph of the percentage of drivers that experienced at least five hard braking events per month over the course of the first year after implementation. As shown in Figure 9, there are several months where the data indicate decreases in effectiveness. This is a natural occurrence, and should not raise concern as long as the measures indicate a trend in the desired direction.

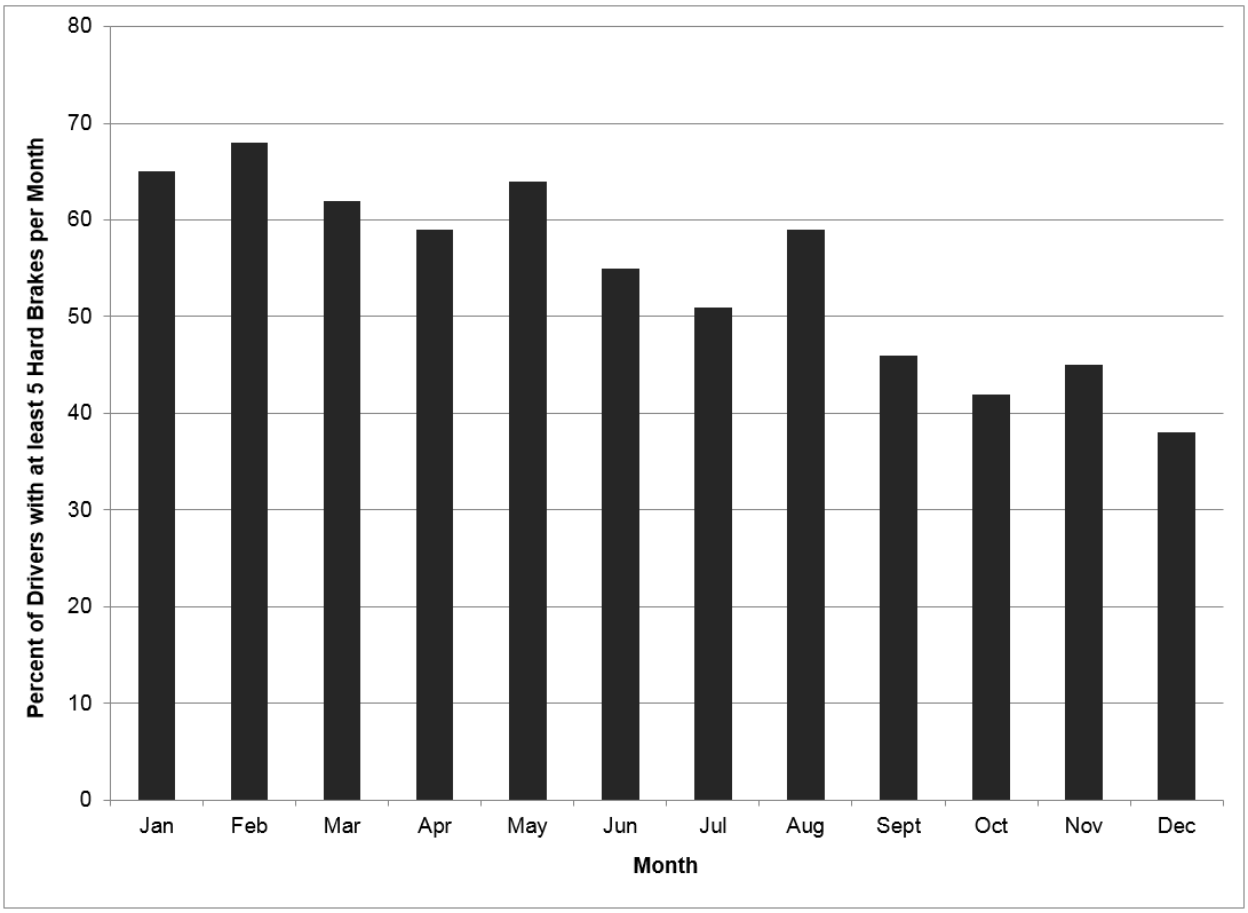

Figure 9. Hypothetical percentage of drivers experiencing at least five hard braking events per month.

Step 3: Identify Emerging Risky Behaviors

When analyzing driving data, various trends may appear, suggesting additional risky driving practices have developed or were not previously recognized. If new risks are identified, review

and/or revise the policy and adjust feedback and driver coaching to include the newly identified risks.

Step 4: Identify Changes Affecting the OSM Program

Operational changes frequently occur in CMV operations, such as new or revised regulations that govern how CMVs operate. These changes may impact the driving practices used by drivers or the effectiveness of current risky driving mitigation strategies. This step in the OSM program evaluation process attempts to identify the impact any of these changes has on the use of safe and risky driving behaviors. Whenever a change occurs, review the data from the OSM system to look for increases or decreases in risky driving behaviors.

Step 5: Improve the Effectiveness of the OSM Program

This step in the OSM program evaluation encourages the continued improvement of the entire OSM program. Only when the OSM program is implemented will there be data to indicate if the OSM program is improving safety-related behaviors. Some risky driving controls or countermeasures may not perform as expected or may no longer be necessary due to the changing operational environment. For example, data may indicate that driver-coaching sessions are not as effective at changing behavior as expected. Upon further examination, it was found that most drivers were being assigned goals rather than developing their own goals. Changes to the driver-coaching protocol should be adjusted to ensure that drivers develop their own goals. If any controls or mitigation strategies are not performing as expected, reevaluate the processes surrounding the OSM program to identify why they are not working. Based on the data gathered, redesign these controls or mitigation strategies to better address risky driving. If the controls or mitigation strategies are effectively reducing risky driving behaviors, it is important to continuously monitor these measures to ensure they remain effective. Additionally, an economic analysis may be performed after the effectiveness evaluation. This analysis may illustrate the savings associated with the OSM program due to reduced crashes, violations, and equipment maintenance.

SUMMARY

Careful consideration is required when developing, implementing, and evaluating the OSM program. This chapter focused on developing a positive safety culture, assembling a steering committee, defining roles and responsibilities for developing an OSM policy, conducting benchmarking, evaluating and selecting an OSM system, developing performance measures, constructing a timeline for implementation, developing accountability, increasing awareness, providing communication, and evaluating and monitoring the OSM program. Each of these stages is critical to the ultimate success of the OSM program.

APPENDIX A. EXAMPLE TERMS OF REFERENCE FOR THE OSM PROGRAM STEERING COMMITTEE (ADAPTED FROM THE DEPARTMENT OF PREMIER AND CABINET, TASMANIA)[60]

Onboard Safety Monitoring Program

Steering Committee Terms of Reference

Version No:

Prepared by:

Date:

Purpose

The Onboard Safety Monitoring (OSM) Program Steering Committee is responsible for coordinating all OSM activities at [*inset company name*]. This includes responsibility for gathering, analyzing, and reporting on data that facilitates the assessment of OSM devices among commercial motor vehicle (CMV) drivers. The OSM Program Steering Committee is also responsible for ensuring that the OSM program meets the safety objectives defined in the OSM Program Policy and that the OSM program facilitates the management of safety risks in general.

Role of the OSM Program Steering Committee

The Roles of the OSM Program Steering Committee are outlined below.

- Take responsibility for the OSM program's feasibility, business plan, and achievement of outcomes.
- Ensure the OSM program's scope aligns with the [*insert company's name*] objectives.
- Provide those directly involved in the OSM program with guidance on OSM issues.
- Address issues that may have major implications on the OSM program.
- Reconcile differences in opinion and approach, and resolve disputes arising from them.
- Report OSM program progress and effectiveness to top management.
- Take responsibility for any company-wide issues associated with the project.

Role of Individual OSM Program Steering Committee Members

The roles of the individual members of the OSM Program Steering Committee are outlined below.

- Understand the strategic implications and outcomes of the OSM program.
- Appreciate the significance of the OSM program for [*insert company name*] and all groups affected by the program.
- Represent the interests of the groups affected by the OSM program.
- Be genuinely interested in the initiatives and outcomes being pursued in the OSM program.
- Be an advocate for the OSM program's outcomes.
- Have a broad understanding of any OSM program management issues and the approach adopted to address those issues.

- Be committed to, and actively involved in pursuing the OSM program's outcomes.

In practice, this means the individual members of the OSM Program Steering Committee:

- ensure the requirements of [*insert company name*] are met by the OSM program;
- help balance conflicting priorities and resources;
- provide guidance to all groups affected by the OSM program;
- consider all ideas, feedback, and concerns raised;
- evaluate the progress of the OSM program; and
- check adherence of the OSM program to recognized best practices, both within [*insert company name*] and industry wide.

OSM Program Steering Committee Membership

The OSM Program Steering Committee will be comprised of at least one member of the following groups:

- Executive Management
- Department of Safety
- CMV Drivers
- Department of Maintenance

The OSM Program Steering Committee is directly responsible to the VP of Safety and reports through the Department of Safety.

Meetings and Reports

The OSM Program Steering Committee will meet monthly. Minutes will be taken during meetings, and full copies of the Minutes, including attachments, will distributed within 10 working days after each meeting. The OSM Program Steering Committee will present an annual budget request in [*designated part of the financial cycle*] and an annual report of all expenditures.

APPENDIX B. EXAMPLE OSM POLICY (ADAPTED FROM CAMDEN ET AL.)[21]

OSM POLICY EXAMPLE 1 (ADAPTED FROM ICAO)[61]

[Insert Company Name] Onboard Safety Monitoring Program Policy

As a commitment to the continuous improvement of safety, [insert company name] has an Onboard Safety Monitoring (OSM) program to manage risky driving behaviors.

This OSM program applies to all operations in [insert company name]. The OSM devices will be installed in all trucks to help improve safety of our drivers and the safety of the general driving public.

Under this policy:

Management is responsible for:

- Providing adequate resources for the OSM program;
- Providing policies that support safe driving practices;
- Providing drivers with adequate opportunities for recovery sleep between duties;
- Creating an environment that promotes open and honest feedback regarding at-risk driving behaviors;
- Providing training to drivers;
- Demonstrating active involvement in and understanding of the OSM program;
- Regularly review safety-related events identified by the OSM system;
- Following up with drivers regarding identified safety-related events to fully understand circumstances surrounding the event;
- Providing timely feedback to drivers regarding safety-related events identified by the OSM system;
- Providing constructive driver coaching sessions to reduce risky driving behaviors and to assist in the development of SMART goals;
- Providing recognition/rewards for goal achievement;
- Regularly consulting with drivers regarding the effectiveness of the OSM program; and
- Demonstrating continuous improvement and providing an annual review of the OSM program.

Drivers are responsible for:

- Participating in training and education;
- Participating in driver coaching sessions;
- Reducing risky driving behaviors while increase safe driving behaviors;
- Developing individualized SMART goals;
- Complying with the FMP Policy;
- Informing their manager or supervisor immediately prior to or during work if;
    - They know or suspect they or another driver are suffering from unacceptable levels of fatigue or engaged in an unsafe driving behavior; or
    - They have any doubt about their or another driver's capability to accomplish their duties.

Driver safety must be considered a core value of our business as it provides a significant opportunity to improve our operation and to maximize the well-being of our staff and the general public.

Policy authorized by:

(Signed)_____

[Insert title of accountable Executive]

Date:_____

OSM POLICY EXAMPLE 2 (ADAPTED FROM ROADS AND TRAFFIC AUTHORITY)[74]

[Insert Company Name] Onboard Safety Monitoring Program Policy

The purpose of this policy is to establish the requirements for managing risky driving in [Insert Company Name]. It is intended that this policy will improve driver safety by reducing the risk of injuries and crashes.

Scope and coverage

This policy applies to all employees, especially those whose work involves shift work, extended hours, and on-call arrangement.

Policy statement

[Insert Company Name] is committed to providing and maintaining safe systems of work for all its employees, including those drivers whose work involves shift work, extended hours, or on-call arrangements.

Onboard safety monitoring (OSM) systems are designed to improve the safety of drivers by monitoring driving habits to identify risky behaviors that may lead to a collision. When coupled with alerts, feedback, and driver coaching, OSM programs attempt to educate and train drivers to avoid risky driving before a collision or near-crash.

The purpose of this program is to improve the safety of [*Insert Company Name*]'s drivers by reducing the number of hard brakes, rapid acceleration, speeding, and hard cornering while increasing safety belt use and following distance.

Responsibilities

Managers and drivers have a responsibility to ensure the safety, health, and well-being of themselves and others.

Under this policy:

Management is responsible for:

- Applying risk management in consultation with staff, especially in consultation with drivers;
- Regularly review safety-related events identified by the OSM system;
- Follow-up with drivers regarding safety-related events and provide timely, constructive feedback and coaching;
- Providing opportunities for drivers to obtain adequate rest from work;
- Creating a culture that promotes a collaboration between drivers and management;
- Consulting with drivers regarding the effectiveness of the OSM program; and
- Providing information, instruction, and training about risky driving and tips and strategies for safe driving.

Drivers are responsible for:

- Participating in risk management processes;
- Using time off from work to recuperate in order to be fit and able for the next shift;
- Participating in education and training in order to gain an understanding of risky driving;
- Avoiding behaviors and practices that are considered risky;
- Developing individualized safety-related goals; and
- Recognizing signs of fatigue that could place health, safety, and well-being of themselves and others at risk and reporting this to their manager or supervisor.

Policy authorized by:

(Signed)_____

[Insert title of accountable Executive]

Date:_____

APPENDIX C. LIST OF CURRENT PROVIDERS OF OSM TECHNOLOGY

The following table lists current providers of OSM systems. These providers were selected based on Trimble and Bowman.[62] Definitions of the OSM features are described below.

- **GPS/Telematics-Based Systems:** Collect driving data via GPS/cellular tracking systems or from the onboard diagnostic port.

- **Video-Based Systems:** Collect driving data via video cameras located inside and/or outside the vehicle. These systems typically have 1, 2, 3, or 4 cameras.

- **Exception-Based Event Recording:** These OSM systems only record and transmit driving data that exceed specified thresholds. Thresholds may be based on exceeding a specified speed or a g-forces experienced during hard braking, rapid acceleration, sharp cornering, etc.

- **Continuous Recording:** These OSM systems continuously record driving data and transmit all data to the back-office system.

- **Detailed Event Reports:** Reports are generated from data collected by the OSM system. These reports may be on a driver, vehicle, or fleet level and may include exception-based alerts, speed history, video data, etc.

- **Driver Scorecards:** The data are analyzed and scored based on predefined criteria. Scores may be based on the frequency of exception-based alerts, a comparison with other drivers in the fleet, or a comparison with drivers in other fleets. Scorecards provide an easy-to-understand method to compare and track drivers' safe and risky driving behaviors overtime.

- **Real-Time Manager Alerts:** The OSM system provides real-time, instant alerts to designated personnel when an exception-based event is detected. These alerts may be via email, text message, or computer message. The alerts typically include driver information, the type of event detected, and a description of the event.

- **In-Cab Feedback:** The OSM system provides instant in-cab driver feedback when an exception-based event is detected. The feedback may be via a blinking light, haptic warning, an audible sound, or a pre-recorded message.

- **Video Replay:** This feature is available with most camera-based OSM systems. Once the videos have been transmitted to the back-office system, managers and drivers can replay video of exception-based alerts to review what occurred.

- **Technical Support and Training:** End-user training that may review how to use the technology features and tools (e.g., device functionality, how to generate reports, analytic training, etc.). This training may be provided to supervisors, managers, dispatchers, and/or drivers.

- **Management Training to Improve Driver Coaching:** Training provided to management that reviews driver coaching tips and techniques, best practices for change management, aligning corporate policies based on the OSM system, how to introduce the OSM system to drivers, gaining driver buy-in, creating OSM program champions, etc.

- **Driver Training:** Training provided directly to drivers that may include information about the OSM system, safe driving practices, defensive driving, etc.

- **Completed by Resellers:** These OSM vendors rely on their resellers to provide training directly to fleets.

- **Offered by Third Parties**: These vendors have partnered with third parties to provide additional training. This training may include driver training and/or management training to improve driver coaching.

Provider	OSM System Type		Exception-Based/ Continuous Recording		Reporting/Alerts					Implementation Training Provided				
	GPS/Telematics Based	Video Based	Exception-Based Events	Continuous Recording	Detailed Event Reports	Driver Scorecards	Real-Time Alerts	In-Cab Feedback	Video Replay	Technical Support and Training	Training to Improve Driver Coaching	Driver Training	Completed by Resellers	Offered by 3rd Parties
Actsoft www.actsoft.com	✓		✓		✓	✓	✓	✓		✓	✓			
AEGIS Mobility www.aegismobility.com/distracted-driving/index.php	✓		✓		✓	✓	✓			✓				
APD www.apdcomms.com	✓		✓		✓		✓			✓	✓			
Applus Technologies http://applustech.com	✓	✓	✓	✓	✓		✓		✓	✓				
AT&T Enterprise www.att.com/fleetcomplete	✓		✓		✓	✓	✓			✓	✓			
Autovision Wireless www.autovisionwireless.com	✓		✓		✓					✓				
Beacon Wireless www.beaconwireless.net	✓		✓		✓		✓			✓				
Blue Tree Systems www.bluetreesystems.com	✓		✓		✓	✓				✓	✓	✓		
BSM Wireless www.bsmwireless.com	✓		✓		✓		✓			✓	✓	✓		
CalAmp Telematic Systems www.calamp.com	✓		✓		✓		✓			✓	✓	✓		

Provider	OSM System Type		Exception-Based/ Continuous Recording		Reporting/Alerts					Implementation Training Provided				
	GPS/Telematics Based	Video Based	Exception-Based Events	Continuous Recording	Detailed Event Reports	Driver Scorecards	Real-Time Alerts	In-Cab Feedback	Video Replay	Technical Support and Training	Training to Improve Driver Coaching	Driver Training	Completed by Resellers	Offered by 3rd Parties
Cellcontrol www.cellcontrol.com	✓		✓		✓		✓			✓				
Certified Tracking Solutions www.certifiedtrackingsolutions.com	✓		✓		✓		✓			✓				
ChoiceTel www.choicetelnetworks.com	✓		✓		✓					✓				
Cimble www.cimble.com	✓		✓		✓		✓			✓				
Collision Avoidance Systems www.collisionavoidancesystems.net	✓	✓	✓		✓		✓	✓		✓	✓	✓		
Ctrack www.ctrack.co.uk	✓		✓		✓	✓	✓	✓		✓	✓			
DPL America www.dplamerica.com	✓		✓		✓		✓			✓	✓			
Dock-N-Lock www.dock-n-lock.com	✓		✓		✓					✓				
Donlen Corp www.donlen.com	✓		✓		✓	✓	✓			✓	✓	✓		
Driver's Alert ww2.driversalert.com	✓		✓		✓	✓	✓				✓	✓		

Provider	OSM System Type		Exception-Based/ Continuous Recording		Reporting/Alerts					Implementation Training Provided				
	GPS/Telematics Based	Video Based	Exception-Based Events	Continuous Recording	Detailed Event Reports	Driver Scorecards	Real-Time Alerts	In-Cab Feedback	Video Replay	Technical Support and Training	Training to Improve Driver Coaching	Driver Training	Completed by Resellers	Offered by 3rd Parties
E-Drive Technology www.e-drivetech.com	✓		✓		✓		✓	✓		✓				
Element Fleet Management www.elementcorp.com/fleet-management	✓		✓		✓					✓	✓			
Encompass Telematics www.encompasstelematics.com	✓		✓		✓		✓	✓		✓				
FieldLogix www.fieldtechnologies.com	✓		✓		✓	✓	✓			✓	✓	✓		
FleetCarma www.fleetcarma.com	✓		✓		✓	✓	✓			✓	✓	✓		
FleetComplete. www.fleetcomplete.com	✓		✓		✓		✓			✓	✓			
FleetLocate www.fleetlocate.com	✓		✓		✓	✓	✓	✓		✓	✓			
Fleetmatics www.fleetmatics.com	✓		✓		✓	✓	✓			✓	✓			
Fluid Mobility www.fluid-mobility.com	✓		✓		✓		✓			✓	✓			
Forward Thinking Systems www.ft-sys.com	✓		✓		✓		✓			✓				

Provider	OSM System Type		Exception-Based/ Continuous Recording		Reporting/Alerts					Implementation Training Provided				
	GPS/Telematics Based	Video Based	Exception-Based Events	Continuous Recording	Detailed Event Reports	Driver Scorecards	Real-Time Alerts	In-Cab Feedback	Video Replay	Technical Support and Training	Training to Improve Driver Coaching	Driver Training	Completed by Resellers	Offered by 3rd Parties
GE Capital Fleet Services www.gefleet.com	✓	✓	✓		✓		✓	✓		✓	✓	✓		
GeoDecisions www.geodecisions.com	✓		✓		✓		✓			✓				✓
Geotab www.geotab.com	✓		✓		✓	✓	✓	✓					✓	
GeoTelematics Solutions, Inc. www.geotelematic.com	✓		✓		✓					✓				
GEOTrac Systems, Inc. www.geotracinternational.com	✓		✓		✓	✓	✓	✓		✓	✓			
Global Resource Group www.grggps.com	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		
Go GPS www.gogps.com	✓		✓		✓	✓	✓	✓		✓	✓	✓		
GpsGate www.gpsgate.com	✓		✓		✓		✓			✓			✓	
GPS Insight www.gpsinsight.com	✓		✓		✓	✓	✓			✓	✓			
GPS North America www.gpsnorthamerica.com	✓		✓		✓		✓			✓	✓	✓		

Provider	OSM System Type		Exception-Based/ Continuous Recording		Reporting/Alerts					Implementation Training Provided				
	GPS/Telematics Based	Video Based	Exception-Based Events	Continuous Recording	Detailed Event Reports	Driver Scorecards	Real-Time Alerts	In-Cab Feedback	Video Replay	Technical Support and Training	Training to Improve Driver Coaching	Driver Training	Completed by Resellers	Offered by 3rd Parties
GPSTrackit.com www.gpstrackit.com	✓		✓		✓		✓	✓		✓				
GreenRoad www.greenroad.com	✓		✓		✓	✓	✓	✓		✓	✓	✓		
Guidepoint www.guidepointsystems.com	✓		✓		✓		✓			✓		✓		
HED www.hedonline.com	✓		✓		✓		✓			✓				
INRIX www.inrix.com	✓		✓		✓		✓			✓				
Insight USA www.streeteaglegps.com	✓		✓		✓	✓	✓			✓	✓			
Integrated Systems Research Corp. www.isrfleettrack.com	✓		✓		✓		✓			✓				
Interactive Driving Systems www.virtualriskmanager.net	✓		✓		✓	✓		✓		✓	✓	✓		
International Road Dynamics, Inc. www.irdinc.com	✓		✓		✓		✓			✓				

Provider	OSM System Type		Exception-Based/ Continuous Recording		Reporting/Alerts					Implementation Training Provided				
	GPS/Telematics Based	Video Based	Exception-Based Events	Continuous Recording	Detailed Event Reports	Driver Scorecards	Real-Time Alerts	In-Cab Feedback	Video Replay	Technical Support and Training	Training to Improve Driver Coaching	Driver Training	Completed by Resellers	Offered by 3rd Parties
Inthinc www.inthinc.com	✓		✓		✓	✓	✓	✓		✓	✓	✓		
iTRAK Corp www.itrak.com	✓		✓		✓		✓			✓				
Keytroller www.keytroller.com	✓	✓	✓	✓	✓			✓	✓	✓				
Lynx Telematics www.lynxtelematics.com	✓		✓		✓		✓			✓	✓	✓		
Lysanda www.lysanda.com	✓		✓		✓					✓				
Lytx www.lytx.com		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		
Manage Mobility http://schooltabletdeployments.com/fleet_management.aspx	✓		✓		✓			✓		✓	✓			
Masternaut www.masternaut.com	✓		✓		✓	✓	✓	✓		✓	✓			
Merchants Fleet Management www.merchantsfleetmanagement.com	✓		✓		✓					✓	✓	✓		

Provider	OSM System Type		Exception-Based/ Continuous Recording		Reporting/Alerts					Implementation Training Provided				
	GPS/Telematics Based	Video Based	Exception-Based Events	Continuous Recording	Detailed Event Reports	Driver Scorecards	Real-Time Alerts	In-Cab Feedback	Video Replay	Technical Support and Training	Training to Improve Driver Coaching	Driver Training	Completed by Resellers	Offered by 3rd Parties
Mike Albert Fleet Solutions www.mikealbert.com	✓		✓		✓		✓			✓	✓			
MiX Telematics www.mixtelematics.net	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Mobile Devices www.mobile-devices.com	✓		✓		✓		✓	✓		✓				
MobileFleet www.mobilefleet.es	✓		✓		✓		✓	✓		✓				
Modus www.moduspowered.com	✓		✓		✓	✓	✓			✓				
Navman Wireless www.navmanwireless.com	✓		✓		✓	✓	✓	✓		✓	✓			
NetworkFleet www.networkfleet.com	✓		✓		✓		✓			✓	✓			
NexTraq www.nextraq.com	✓		✓		✓	✓	✓			✓	✓	✓		
Novatel Wireless www.novatelwireless.com	✓		✓		✓		✓			✓				
Omnitracs www.omnitracs.com	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓		

Provider	OSM System Type		Exception-Based/ Continuous Recording		Reporting/Alerts					Implementation Training Provided				
	GPS/Telematics Based	Video Based	Exception-Based Events	Continuous Recording	Detailed Event Reports	Driver Scorecards	Real-Time Alerts	In-Cab Feedback	Video Replay	Technical Support and Training	Training to Improve Driver Coaching	Driver Training	Completed by Resellers	Offered by 3rd Parties
Orion Fleet Intelligence www.orionfi.com	✓		✓		✓		✓			✓	✓	✓		
Pedigree Technologies www.pedigreetechnologies.com	✓		✓		✓		✓			✓		✓		
PeopleNet www.peoplenetonline.com	✓		✓		✓		✓	✓		✓	✓	✓		
PHH Arval www.phharval.com	✓		✓		✓	✓	✓	✓						
PinPoint GPS Solutions, Inc. www.pinpointgps.ca	✓		✓		✓	✓	✓	✓		✓				
Pinpoint Telematics www.pinpointers.com	✓		✓		✓		✓			✓				
Pointer Telocation LTD www.pointer.com	✓	✓	✓		✓	✓	✓	✓		✓			✓	✓
Reltima www.reltima.com	✓		✓		✓		✓			✓		✓		
Roadnet Technologies, Inc. www.roadnet.com	✓		✓		✓					✓	✓			
Routeware www.routeware.com	✓	✓	✓		✓	✓	✓			✓	✓	✓		

Provider	OSM System Type		Exception-Based/ Continuous Recording		Reporting/Alerts					Implementation Training Provided				
	GPS/Telematics Based	Video Based	Exception-Based Events	Continuous Recording	Detailed Event Reports	Driver Scorecards	Real-Time Alerts	In-Cab Feedback	Video Replay	Technical Support and Training	Training to Improve Driver Coaching	Driver Training	Completed by Resellers	Offered by 3rd Parties
Ruptela Mobile Solutions www.ruptela.com	✓		✓		✓		✓			✓				
Scania Fleet Management www.scania.com/products-services/services/fleet-management	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓		
Shaffer Communications, Inc. www.shaffercomm.com	✓		✓		✓		✓			✓				
Skypatrol www.skypatrol.com	✓		✓		✓		✓			✓				
SmartDrive Systems www.smartdrive.net	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓		
Sprint www.sprint.com/business	✓		✓		✓	✓	✓	✓		✓				
Sycada www.sycada.com	✓		✓		✓		✓			✓	✓			✓
Teletrac www.teletrac.com	✓		✓		✓	✓	✓			✓	✓	✓		
Telogis www.telogis.com	✓		✓		✓	✓	✓			✓		✓		

Provider	OSM System Type		Exception-Based/ Continuous Recording		Reporting/Alerts					Implementation Training Provided				
	GPS/Telematics Based	Video Based	Exception-Based Events	Continuous Recording	Detailed Event Reports	Driver Scorecards	Real-Time Alerts	In-Cab Feedback	Video Replay	Technical Support and Training	Training to Improve Driver Coaching	Driver Training	Completed by Resellers	Offered by 3rd Parties
Topcon Positioning Systems www.topconpositioning.com	✓		✓		✓		✓			✓				✓
TomTom Telematics business.tomtom.com/en_us	✓		✓		✓	✓	✓	✓		✓			✓	
Track Star International, Inc. www.trackstar.com	✓		✓		✓		✓			✓				
Track What Matters www.trackwhatmatters.com	✓		✓		✓		✓			✓				
Tracking The World www.trackingtheworld.com	✓		✓		✓		✓			✓				
Traffilog www.traffilog.com	✓		✓		✓		✓	✓		✓	✓	✓		
Trakm8 www.trakm8.com	✓		✓		✓		✓	✓		✓	✓			
Transpoco www.transpoco.co.uk	✓		✓		✓	✓	✓			✓	✓			
Transport Management Solutions (TMS2) www.tms2.co.uk	✓	✓	✓		✓	✓	✓	✓	✓	✓				
Trapeze Group www.trapezegroup.com/	✓		✓		✓	✓	✓			✓				

Provider	OSM System Type		Exception-Based/ Continuous Recording		Reporting/Alerts					Implementation Training Provided				
	GPS/Telematics Based	Video Based	Exception-Based Events	Continuous Recording	Detailed Event Reports	Driver Scorecards	Real-Time Alerts	In-Cab Feedback	Video Replay	Technical Support and Training	Training to Improve Driver Coaching	Driver Training	Completed by Resellers	Offered by 3rd Parties
Trimble www.trimble.com/FSM/Index.aspx	✓		✓		✓	✓	✓	✓		✓	✓	✓		
Universal Tracking Solutions www.gpsyourfleet.com	✓		✓		✓		✓			✓				
Vehicle Tracking Solutions www.vehicletrackingsolutions.com	✓		✓		✓		✓			✓				
Verizon Telematics www.verizontelematics.com	✓		✓		✓	✓	✓			✓				
Webtech Wireless www.webtechwireless.com	✓		✓		✓	✓	✓			✓	✓	✓		
WEX Telematics www.wextelematics.com	✓		✓		✓		✓			✓				
XRS www.xrscorp.com	✓		✓		✓	✓	✓			✓	✓	✓		
Zen-tinel www.zen-tinel.com/	✓	✓	✓	✓	✓		✓		✓	✓				
Zonar www.zonarsystems.com	✓		✓		✓		✓			✓	✓			
Zurich Fleet Intelligence www.zurichfleetintelligence.com	✓		✓		✓	✓					✓			✓

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