CHAPTER **4**

CARRIER SAFETY MANAGEMENT METHODS

This chapter discusses various elements and approaches to carrier safety management, including findings from the literature review, and provides results for specific survey questions relating to these methods. In interpreting the survey results, recall that the safety manager sample is arguably biased toward safety-conscious managers, for example, those who are members of trade association safety councils or attend safety conferences. Only those safety managers who used a particular method in their fleets were asked to rate it for effectiveness, so the mean effectiveness ratings are based on those using the method. In contrast, all of the other expert respondents were asked to rate and rank all of the safety management methods.

4.1 DRIVER RECRUITING AND SELECTION

As stated in *SafeReturns* (ATAF 1999a), "starting with the right people is key to overall safety performance." Recall from Chapter 3 the high importance placed on driver behaviors and high-risk drivers. To the extent that the "80–20" rule applies, fleets who rarely or never hire a driver from the "bottom 20" may be eliminating the majority of their potential crash risk and liability.

Specific practices recommended in *SafeReturns* include requiring in-person applications, personal interviews, screening for stable employment history, maximum point limits for moving violations, minimum years of experience, driving tests, requiring a physical examination, and reviewing the past financial performance (e.g., credit rating) of owner–operators.

The *Truck Driver Risk Assessment Guide* (ATAF 1999b) elaborates on recruiting methods necessary to target safe drivers, in particular recruiting ads that include (a) company practices relevant to safety (e.g., regular schedules, well-maintained equipment), (b) specific safety-related criteria for employment (e.g., minimum age, years of experience, driving record), (c) specific "dos and don'ts" for employment applications forms and structured interviews, and (d) federal regulations on required background checks as well as additional recommended background checks. A detailed driving road test checklist is provided for use by fleets in screening drivers. In addition, the guide discusses the use of commercial services providing employment-related databases and personality inventories or other psychological tests purported to predict commercial driver safety.

In the I-95 Corridor Coalition Coordinated Safety Management study (Stock 2001), virtually all respondents considered safety-related hiring criteria to be important to safety. More than 90% of fleets required in-person interviews, called past employers to review employment histories, tested for alcohol and drugs during screening, and conducted on-road driving tests before hiring. Percentages relating to other specific practices were somewhat lower:

- Use of third party services to review driver histories: 36%;
- Requiring a minimum number of years of experience: 56%;
- Specific maximum number of points/crashes/violations: 82%; and
- Requiring a written test on DOT regulations: 41%.

The FMCSA/UM Survey of Safest Motor Carriers (Corsi and Barnard 2003) identified a number of driver characteristics considered most important by their respondents in making hiring decisions for company drivers. These included lack of prior dismissals for alcohol and drugs, lack of past chargeable crashes, driving experience with other carriers, no prior traffic violations, solo driving experience, recommendations from other carriers, and being age 25 years or older. The same factors were considered most important for owner–operators as well. Essential driver personality traits included reliability, honesty, self-discipline, self-motivation, and patience. Best hiring practices identified included traffic record checks, drug testing, test drives, license qualification checks, interviews, DOT "fit for work" physical exams, and past employment reference checks.

Improved "people management," including selection and hiring, was one of the top ten recommendations from the *International Truck & Bus Safety Research & Policy Symposium*, conducted in Knoxville in April 2002 (Zacharia and Richards 2002). A specific recommendation was to improve data collection and access to driver employment history.

Appendixes E-1 through E-4 contain CMV fleet safety management tools relating to the selection and hiring process. The following two survey items related to hiring practices:

Method 1a. Requiring that new hires meet or exceed a minimum number of years of experience.

Respondent Type	% Who Use	Effectiveness Rating		"Top Five" Selections	
		Mean	Rank (of 28)	% of Respondents	Rank (of 28)
Safety Managers	**86%**	**4.15**	**4**	**46%**	**2**
Other Experts		**3.55**	**24**	**13%**	**15**

Method 1b. Hiring based on criteria relating to driver crash, violation, or incident history.

Respondent Type	% Who Use	Effectiveness Rating		"Top Five" Selections	
		Mean	Rank (of 28)	% of Respondents	Rank (of 28)
Safety Managers	**90%**	**4.19**	**2**	**53%**	**1**
Other Experts		**4.36**	**2**	**54%**	**1**

The vast majority of the safety manager respondents used these techniques, and they rated them very high in effectiveness. Hiring based on criteria relating to driver history was among the very highest-rated safety management methods. Other expert respondents supported the use of hiring criteria relating to driver history (Method 1b), but were not highly supportive of using a criterion of years of experience for new hires (Method 1a). One other expert respondent suggested that employment history in itself could also be predictive of CMV driving safety performance, for example, frequent past job changes may be associated with increased safety risk.

4.2 FLEET-BASED DRIVER TRAINING

As noted in Chapter 3, entry-level training of CMV drivers is widely regarded as deficient in relation to the safety requirements of the job. A study published by the Office of Motor Carriers in 1995 concluded that only 31% of entry-level truck drivers receive adequate entry-level training (FHWA 1995; Johnson 1997). This has prompted fleets to rely heavily on their own training programs for new hires. Of those fleets surveyed by in *SafeReturns* (ATAF 1999a), only 14% relied on outside-certified driving schools for driver training and education. Eighty-five percent maintained their own in-house driver training programs. Most fleets (91%) hire new drivers in a probationary status, and then have them train with a driver trainer or senior driver. In-house training programs for new hires generally include three areas: (a) administrative, policies and procedures, (b) equipment loading and operation and customer relations, and (c) long-term safety and skills training. Almost 30% of *SafeReturns* fleets required defensive driving instruction, usually conducted annually.

In the I-95 Corridor Coalition Coordinated Safety Management study (Stock 2001), almost all fleets reported training new drivers in company polices and procedures (including equipment inspection), and most included training in federal and state safety regulations. About 75% require new drivers to train with an experienced driver before soloing. Twenty-three percent require attendance at defensive driving courses. Eighty-three percent of their respondents rated in-house training programs as being important to carrier safety.

The FMCSA/UM Survey of Safest Motor Carriers (Corsi and Barnard 2003) found that 83% of its respondents required pre-service training (i.e., for new hires), usually of 1 to 2 weeks duration. Eighty-seven percent required in-service training (e.g., refresher training). Most of their respondents (57%) felt the two training approaches had an equal safety impact, but, of the remainder, in-service training was rated as having greater impact by more respondents (31%) than was pre-service training (12%). The most frequent topics covered in pre-service and in-service training included accident notification, defensive driving, dispatch procedures, driver disciplinary policies, federal safety regulations, hazardous material handling, hours-of-service regulations, injury prevention, pre- and post-trip inspections, and truck maintenance.

Improved commercial driver training was the No.1 recommendation from the *International Truck & Bus Safety Research & Policy Symposium*, conducted in Knoxville in April 2002 (Zacharia and Richards 2002). This recommendation focused largely on entry-level training in schools but also noted the safety opportunities from improved driver training on the job.

Appendix E contains CMV fleet safety management tools relating to in-service driver training programs. In addition,

Appendix E contains specific tips on driving practices, as might be covered in training programs or safety meetings. The project survey contained four relevant items, as follows:

Method 2a. Standardized training for all new hires (e.g., company policy and procedures, customer relations, defensive driving skills, rules for driving [e.g., speeding, headway]).

		Effectiveness Rating		"Top Five" Selections	
Respondent Type	% Who Use	Mean	Rank (of 28)	% of Respondents	Rank (of 28)
Safety Managers	**87%**	**4.11**	**6**	**40%**	**3**
Other Experts		**4.18**	**4**	**32%**	**5**

Method 2b. Apprenticeship and "finishing" programs for new drivers, conducted by a safety manager or senior driver.

		Effectiveness Rating		"Top Five" Selections	
Respondent Type	% Who Use	Mean	Rank (of 28)	% of Respondents	Rank (of 28)
Safety Managers	**51%**	**4.01**	**9**	**15%**	**17**
Other Experts		**4.36**	**2**	**27%**	**6**

Method 2c. Regular refresher training for all drivers.

		Effectiveness Rating		"Top Five" Selections	
Respondent Type	% Who Use	Mean	Rank (of 28)	% of Respondents	Rank (of 28)
Safety Managers	**63%**	**3.94**	**16**	**16%**	**15**
Other Experts		**4.18**	**4**	**24%**	**7**

Method 2d. Remedial training programs for problem drivers.

		Effectiveness Rating		"Top Five" Selections	
Respondent Type	% Who Use	Mean	Rank (of 28)	% of Respondents	Rank (of 28)
Safety Managers	**69%**	**3.99**	**10**	**14%**	**20**
Other Experts		**4.14**	**6**	**21%**	**10**

These results indicate widespread use and generally strong support for various in-fleet training approaches. Most safety managers reported using these methods and assigned the highest effectiveness ratings to standardized training for all new hires (Method 2a). In their comments, safety managers noted the difficulty of recruiting fully-qualified drivers, and thus the need to provide training for new hires as a standard practice. Their effectiveness ratings for apprenticeship/finishing programs (Method 2b), regular refresher training for all drivers (Method 2c), and remedial training programs (Method 2d) were not as high, however. Other expert respondent ratings and rankings for these training solutions were even higher, across all four items, than those of the safety managers.

4.3 SAFETY MEETINGS

Safety meetings including managers, dispatchers, drivers, and other safety-related fleet personnel are a basic and useful means to promote and sustain safety awareness and prescribed safety practices within fleets. *SafeReturns* (ATAF 1999a) found that virtually all fleets interviewed hold regularly scheduled safety meetings, generally with mandatory attendance and paid attendance for drivers. Topics frequently

addressed include accidents or incidents occurring recently, vehicle maintenance and inspection, defensive driving, driver health and lifestyle (e.g., diet), winter driving, and non-driving topics such as loading dock practices and hazardous material handling.

In the I-95 Corridor Coalition "Best Practices" study (Stock 2001), just more than one-half of small fleets (1–9 vehicles) hold regularly scheduled safety meetings, but nearly 90% of large fleets and bus fleets hold such meetings. Eighty-seven percent of their respondents rated safety meetings as being important to carrier safety.

Regular safety meetings also afford fleets the opportunity for drivers to become more actively involved in fleet safety issues and for them to have two-way communication. The FMCSA/UM Survey of Safest Motor Carriers (Corsi and Barnard 2003) found strong respondent agreement with the following statements:

- "Our employees feel comfortable discussing highway safety issues with their supervisors."
- "Many ideas about improving the firm's highway safety come from our employees."
- "Employees frequently voice highway safety concerns to supervisors."

The project survey contained the following item on safety meetings:

office between runs. One specific topic suggested was the consequences for companies when drivers are noncompliant, have traffic violations, or are involved in crashes. The whole fleet and company can suffer negative consequences from a few problem drivers. Finally, for fleets with non-English-speaking drivers, it was suggested that safety meetings include interpreters so that these drivers do not feel excluded and that they get the same safety information as the other drivers.

4.4 DRIVER SAFETY ASSESSMENT

Observation and feedback, in their various forms, are key processes in continuously maintaining and promoting driver safety. The *Truck Driver Risk Assessment Guide* (ATAF 1999b) notes that in-service performance evaluation is a way for fleets to measure their risks, provide countermeasures, maintain performance expectations, and promote meaningful safety-focused communication. A multitude of elements of driver performance can be monitored including (a) driving skills, (b) driving habits, (c) hours-on-duty, (d) miles driven and moving violations, (e) accidents and cargo loss, (f) vehicle inspection and maintenance, and (g) non-driving activities such as loading and unloading practices. Tools provided in the guide to assist driver safety assessment include a detailed outline of driver performance standards by driving task, driver evaluation form, sample positive and negative

Method 3. Regularly-scheduled safety meetings.

		Effectiveness Rating		"Top Five" Selections	
Respondent Type	% Who Use	Mean	Rank (of 28)	% of Respondents	Rank (of 28)
Safety Managers	**75%**	**3.96**	**14**	**31%**	**8**
Other Experts		**3.57**	**22**	**7%**	**22**

Most safety-conscious managers conduct regularly-scheduled meetings, but they were not rated among the most effective methods. Perhaps they are considered essential but not, in themselves, highly effective. On the other hand, 31% of safety manager respondents rated this as a "Top 5" practice, indicating that many support its effectiveness. One safety manager respondent felt that safety meetings were most effective when they were primarily positive rather than negative, for example, when they were used to recognize superior safety performance. Another suggested bringing in outside professionals or safety managers from other company divisions (in large companies) to introduce more variety in the meetings. Still another suggested that individual one-on-one meetings with drivers are just as important; he suggested this should be a regular practice, whenever possible, when drivers are at the fleet

evaluation letters to drivers, employee appraisal form, accident follow-up procedures (both for drivers and managers who conduct follow-up investigations), and guidelines on the use of observation and feedback in behavior-based safety (BBS) (discussed in Section 4.6).

In the I-95 Corridor Coalition Coordinated Safety Management study (Stock 2001), "driver monitoring" was considered important to safety by more than 90% of the respondents. Almost all respondents continuously monitored citations. About one-third actually observed in-service drivers on the road, with larger fleets much more likely to use this technique than smaller fleets.

Tracking fleet safety statistics helps to assess overall fleet safety performance, identify risk factors (e.g., common crash types or locations), and evaluate the effects of safety programs implemented in the fleet.

Appendix E contains a road test evaluation form designed for evaluating prospective new hires, but which could also be used in ride-alongs. Appendix E also contains other job aids relevant to driver performance monitoring, evaluation, coaching, and accident investigation. The project survey contained four related items, as follows:

Method 4a. Observation of driving behaviors through ride-alongs.

Respondent Type	% Who Use	Effectiveness Rating		"Top Five" Selections	
		Mean	Rank (of 28)	% of Respondents	Rank (of 28)
Safety Managers	**48%**	**4.07**	**8**	**31%**	**8**
Other Experts		**3.55**	**24**	**13%**	**15**

Method 4b. Continuous tracking of driver's crashes/incidents/violations.

Respondent Type	% Who Use	Effectiveness Rating		"Top Five" Selections	
		Mean	Rank (of 28)	% of Respondents	Rank (of 28)
Safety Managers	**92%**	**4.16**	**3**	**24%**	**12**
Other Experts		**4.46**	**1**	**38%**	**2**

Method 5. Tracking of overall fleet safety statistics (e.g., fleet crash/violation rate).

Respondent Type	% Who Use	Effectiveness Rating		"Top Five" Selections	
		Mean	Rank (of 28)	% of Respondents	Rank (of 28)
Safety Managers	**88%**	**3.98**	**11**	**13%**	**24**
Other Experts		**4.00**	**10**	**15%**	**13**

Method 11. Crash and incident investigation by carrier management (e.g., visit to crash site, completion of company forms, in-house review panel, final determination of fault/preventability with recommendations).

Respondent Type	% Who Use	Effectiveness Rating		"Top Five" Selections	
		Mean	Rank (of 28)	% of Respondents	Rank (of 28)
Safety Managers	**83%**	**4.13**	**5**	**27%**	**11**
Other Experts		**4.00**	**10**	**18%**	**12**

As shown, most safety-conscious fleet managers employ these techniques, with the exception of observation through ride-alongs, which are used by about one-half of the safety managers. A criticism of ride-alongs was that they are too time-consuming to be cost-effective. On the other hand, they afford safety managers an opportunity to interact one-on-one with drivers to develop rapport, assess drivers' safety strengths and weaknesses, and personally communicate management's expectations regarding driving safety. Safety managers indicated high use and effectiveness ratings for continuous tracking of driver crashes/incidents/violations (Method 4b) and for crash and incident investigation by carriers (Method 11). Other experts assigned the No. 1 effectiveness rating of the 28 methods rated to continuous tracking.

One safety manager respondent believed that his fleet had excellent administrative tools and procedures for tracking driver safety performance, but little time for follow-up activities such as counseling, training, discipline, and reward programs for safe driving. He attributed this deficiency to the lack of a safety management staff. Another company created a Driver Advisory Board, elected by the fleet, to handle a large portion of driver performance monitoring and corrective counseling.

4.5 DRIVER INCENTIVE PROGRAMS

Driver incentive programs provide economic rewards to drivers for the "bottom line" of safety—crash-free driving or other similar outcome measures, such as low involvement in

incidents and low traffic violations rates. Economic factors are probably among the primary determinants of behavior in CMV drivers. Since CMV drivers are usually paid by the mile, at-risk behaviors may be an unintended consequence (Wilde, Saccomanno, and Shortreed 1996). If economic factors tend to motivate CMV drivers to accept higher levels of risk, other economic factors may be necessary to reduce or reverse this tendency.

Financial and other tangible rewards for safety are widely, though often unsystematically, employed in the North American CMV industry. In a study conducted by Barton and Tardiff (1998), 28 of the 40 (70%) trucking firms surveyed had an incentive/reward program. In the I-95 Corridor Coalition "Best Practices" study (Stock 2001), only about 25% of small fleets (1 to 9 vehicles) had financial reward programs for safe driver performance, but the percentage was more than 80% for larger fleets (51+ vehicles). Most safety managers surveyed generally rated such programs as important to safety. In *SafeReturns* (ATAF 1999a), 41% of all fleets surveyed and 66% of "award winning" fleets provided cash bonuses to drivers for their safety performance. At the June 2001 Pittsburgh fleet safety conference sponsored by the 21st Century Driver and Truck Alliance (Grace and Suski 2001), one of the top seven safety action items adopted by the conference was to promote incentive and other safety programs with demonstrated success, particularly targeting small fleets.

In Canada, a series of studies have reviewed the potential to improve trucking safety through incentive programs (Barton and Tardif 2002). Recommended elements of effective incentive programs include strong management commitment, involvement, and support; planning in consultation with drivers; attractive, tangible rewards contingent on noninvolvement in preventable crashes; rewards perceived as equitable and attainable; and encouragement of driver group norms supporting safe conduct. In pilot evaluations of incentive programs, Barton and Tardif (2002) reported significant crash and incident reductions and, in particular, substantial reductions in driver turnover rates.

The FMCSA/UM Survey of Safest Motor Carriers (Corsi and Barnard 2003) reported that 77% of its respondents have safety reward programs for individual drivers, with even higher percentages for larger carriers. Types of rewards included verbal praise (93%), public recognition (72%), letters from management (70%), safety decorations (69%), cash (66%), and merchandise (65%). Frequent criteria cited were all outcome-based as opposed to behavior-based; they included crashes, FMCSR violations, traffic violation convictions, and public complaints. Ordinarily, these were time-based rather than mileage-based, for example, a reward might be provided for 1 year of crash-free driving. When asked to compare the relative effectiveness of safety *rewards* versus *disciplinary actions*, 44% of their respondents rated them as having equal impact, while 33% and 22% favored safety rewards and disciplinary actions, respectively.

Appendix E contains a program summary and award schedule for the driver safety incentive program of a commercial truck carrier. The project survey contained the following item on incentive programs:

Method 6. Driver incentive programs for outcome-based safety measures (i.e., reward for crash-free miles).

		Effectiveness Rating		"Top Five" Selections	
Respondent Type	% Who Use	Mean	Rank (of 28)	% of Respondents	Rank (of 28)
Safety Managers	**73%**	**3.83**	**21**	**28%**	**10**
Other Experts		**3.89**	**14**	**20%**	**11**

Although a clear majority of safety manager respondents employed incentives for drivers, the effectiveness ratings and rankings assigned by them were near the middle of the solution set distribution. The same was true for other expert respondents. One other expert respondent expressed the view that incentive programs must be comprehensive to be successful; that is, driver pay should be strongly related to safety performance and less related to mileage. Driver incentive programs are addressed again in Chapter 5.

4.6 BEHAVIOR-BASED SAFETY

BBS is a set of methods to improve safety performance by teaching workers to identify critical safety behaviors, perform observations to gather data, provide feedback to each other to encourage improvement, and use gathered data to target system factors for positive change. BBS combines the principles of behavior modification, quality management, organization development, and risk management. It is an employee-driven, continuous improvement process that focuses on changing behavior, as opposed to focusing directly on crashes and incidents. Its focus on behavior, as opposed to outcomes, distinguishes it from most conventional safety incentive approaches (Geller 2001; Krause 1999).

A key to behavior change in BBS is feedback. Feedback provides accurate information on performance, increases self-observation, communicates a standard, strengthens safety

culture and motivation (e.g., through peer group norms), and uncovers barriers to positive change.

For the past twenty years, BBS has been used successfully in the prevention of occupational injuries, mostly in manufacturing and maintenance settings (e.g., Geller and Hahn 1984; Smith, Anger, and Ulsan 1978). Guastello (1993) reviewed 53 occupational safety and health studies and found BBS to be the most effective type of safety intervention, with an average injury reduction rate of 60%.

Unfortunately, there are very few published studies assessing the effectiveness of BBS with commercial drivers. Most commercial driving settings do not lend themselves easily to key BBS techniques, such as direct behavioral observation and feedback. One variation of BBS, designed for situations where employees work alone (such as commercial driving), is self-management. Hickman and Geller (2002) instructed short-haul truck drivers at two trucking terminals in several self-management strategies including (a) identification of antecedents and consequences of at-risk driving behaviors, (b) goal setting strategies, (c) self-rewards, (d) peer support, and (e) how to self-observe their own safety-related work behaviors using a self-monitoring form. The data suggest that using self-management strategies with professional drivers is not only feasible, but also results in significant decreases in at-risk driving behaviors (extreme braking and overspeed). Similar self-management techniques have been reported to be successful in other commercial driving studies (Olson and Austin 2001; Krause 1997).

The project survey contained one item on the use of BBS and its specific techniques:

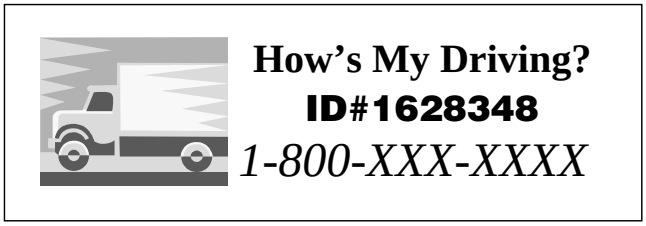

Figure 3. "How's My Driving" safety placard.

4.7 SAFETY PLACARDS

Safety placards (e.g., How's My Driving?), such as those displayed in Figure 3, are promoted as a means to (a) hold drivers accountable for their driving behavior, (b) reduce crash rates and costs, and (c) provide good public relations by showing other motorists that transport companies care about safety. From the public relations perspective, these vehicles may be considered moving billboards for a company.

Typically these safety placards are affixed to the rear of trailers. Displayed on the placard are the driver's personal identification number and an 800 number. The 800 number links to the company's safety department or a third-party monitoring service.

Once a call is received, an incident report is created, if necessary, for both complaints and compliments. This incident report is sent to the fleet safety manager or supervisor for review. The driver is consulted to ascertain his or her side of the story and the incident report is returned with these comments. A summary statement is formulated compiling all the reported information and corrective action, if deemed necessary, is taken.

Potentially, the use of safety placards can help fleet safety managers identify risky drivers before a crash, thus allowing for preventive action. Commercial motor vehicle drivers who have "How's My Driving" safety placards affixed to their vehicles are aware their driving performance is being monitored by other motorists, and thus may feel more accountable for their behavior. Both drivers and fleet safety managers can

Method 7. Behavior-based safety (i.e., observation, self-observation, feedback, incentives focused on safety-related driving behaviors [e.g., safety belt use, safe speeds, safe headways]).

		Effectiveness Rating		"Top Five" Selections	
Respondent Type	% Who Use	Mean	Rank (of 28)	% of Respondents	Rank (of 28)
Safety Managers	**59%**	**3.80**	**22**	**14%**	**20**
Other Experts		**3.95**	**12**	**20%**	**11**

From the survey, it appears that a majority of fleet safety managers employ BBS techniques. It is possible, however, that respondents were answering in relation to one or two specific techniques (e.g., feedback to drivers) rather than to the use of BBS in an overall, systematic way. Most of the safety managers and other expert ratings and rankings were in the lower one-half of the solution set distribution. Because of its widespread use in other industries and demonstrated effectiveness, behavioral safety management is one of the major themes identified in this research project and will be discussed in more detail in Chapter 5.

receive valuable feedback on safety-related driver performance. This feedback can be used for corrective action, retraining, or commendations.

The project survey contained one item on the use of safety placards:

Method 12. "How's My Driving" placards and 800 numbers.

Respondent Type	% Who Use	Effectiveness Rating		"Top Five" Selections	
		Mean	Rank (of 28)	% of Respondents	Rank (of 28)
Safety Managers	**22%**	**3.50**	**25**	**16%**	**15**
Other Experts		**2.61**	**28**	**5%**	**24**

In the project survey, a surprisingly small percentage of safety manager respondents employed these safety placards, and they did not receive high effectiveness ratings. One experienced safety manager felt that "really bad" fleets might benefit from the use of safety placards, but that better fleets used more comprehensive methods such as on-board safety monitoring, with evaluation by safety managers. The use of safety placards is described in more detail in Chapter 5.

4.8 ON-BOARD MONITORING AND RECORDING

Given the distributed operations of commercial driving and the difficulties of obtaining reliable, naturalistic observations of driver behavior, one concept is to employ on-board monitoring and recording devices to obtain behavioral and performance observations. Many behavioral correlates of safe or unsafe driving can be directly measured and recorded, including driving speed, acceleration (longitudinal and lateral), brake use, and driving times (i.e., for HOS compliance monitoring). Newly marketed sensors can continuously measure forward headway, rollover risk on curves, lane tracking, lateral encroachment sensing (e.g., during lane changes), and even driver alertness. Such technologies may provide safety performance feedback, both to drivers and their managers, in addition to providing collision warnings. Based on the behavioral principle that feedback enhances performance and on the success of BBS and safety incentive programs, it is logical to believe that on-board monitoring feedback, if employed within an overall fleet safety management program, could lead to both short- and long-term improvements in driver safety behavior (Knipling and Olsgard 2000).

The most important challenge in applying on-board safety monitoring (OBSM) to CMV driver safety management is likely to be achieving driver acceptance. A 1995 study by Penn + Schoen Associates, Inc., for example, documented commercial driver resistance to OBSM. The study found that commercial drivers were wary of technologies perceived as invasions of privacy or as diminishing the role of driver judgment. Drivers also tended to be skeptical regarding technologies that they had not yet used. Of six technologies considered in the study, OBSM was the least accepted technology by the drivers, even though they generally acknowledged its potential safety benefits.

Perhaps a key to achieving acceptance and ensuring positive behavior change using on-board monitors is to employ BBS techniques proven in other settings, such as positive consequences (rewards) for safety behaviors. Another approach is to remove the privacy concern by making the driver the sole "owner" of the monitoring data; that is, provide feedback to the driver on his or her safety performance without management review of the data. Behavior change in such a case would result from the driver adopting self-management methods to improve safety performance levels. In such an approach, OBSM data could be used to a exonerate driver following a crash or other incidents. This possibility should be emphasized to drivers during orientation and training on the use of OBSM systems. Another benefit for drivers is the added security provided by OBSM systems that incorporate global positioning systems (GPS). Some of these systems include a "panic button" that drivers can use to alert dispatchers to a possible security problem.

A related on-board monitoring and recording technology is the event-data recorder used to capture and record driving performance parameters associated with a crash. Such data can be accessed by crash reconstructionists to determine pre-crash driver actions and performance, such as speed, braking, and steering. In situations of litigation, the data could be used to exonerate or lessen the liability of drivers. Unfortunately, event-data recorders could also be a liability threat to commercial drivers and their companies in at-fault crash situations, and this perceived vulnerability has limited the use of event-data recorders by commercial fleets.

In the I-95 Corridor Coalition "Best Practices" study (Stock 2001), about one-third of the fleets indicated that they "monitor driver/vehicle performance via on-board recorders or vehicle tracking," although this percentage likely includes many fleets that use on-board technologies primarily for operational management instead of safety. Operational management applications include fuel use monitoring and vehicle location tracking.

In the FMCSA/UM Survey of Safest Motor Carriers (Corsi and Barnard 2003), speed monitors/regulators and engine diagnostics monitoring were used by a majority of respondents, with higher percentages reported for larger carriers than smaller carriers.

The project survey contained three items relating to the use of on-board monitoring devices:

Method 8. On-board computer monitoring devices with management review, feedback, and rewards/punishments for good/poor performance.

Respondent Type	% Who Use	Effectiveness Rating		"Top Five" Selections	
		Mean	Rank (of 28)	% of Respondents	Rank (of 28)
Safety Managers	**36%**	**3.85**	**18**	**33%**	**7**
Other Experts		**3.86**	**16**	**22%**	**9**

Method 9. On-board computer monitoring (e.g., speed monitoring) without management review.

Respondent Type	% Who Use	Effectiveness Rating		"Top Five" Selections	
		Mean	Rank (of 28)	% of Respondents	Rank (of 28)
Safety Managers	**21%**	**3.09**	**28**	**9%**	**27**
Other Experts		**3.05**	**27**	**5%**	**24**

Method 10. Event-data recorders ("black boxes") used to reconstruct crashes and incidents.

Respondent Type	% Who Use	Effectiveness Rating		"Top Five" Selections	
		Mean	Rank (of 28)	% of Respondents	Rank (of 28)
Safety Managers	**24%**	**3.59**	**24**	**17%**	**14**
Other Experts		**3.41**	**26**	**7%**	**22**

Overall, these methods don't appear to be widely used or supported by fleet safety managers. There is an interesting contrast, however, relating to Method 8 in the survey form. The mean *rating* assigned by users of this method is ranked 18th of 28 solutions, but 33% of users *ranked* it in the "Top 5" methods, which was 7th of 28 solutions. It appears from these statistics that some managers strongly support the use of on-board monitoring (with management review), even though the majority do not. Method 9 received very low ratings and rankings, apparently indicating that both managers and other experts believe that management review and feedback are essential components of an on-board safety monitoring program.

One senior safety director pointed out some of the challenges safety managers face in employing OBSM. Data archiving, downloading, reduction, and analysis are awkward and difficult with some commercial systems. If not performed frequently, the data become "stale" and, therefore, less compelling both to drivers and to managers. Poor safety performance (e.g., high speeds) may be more apparent in the data than good performance, thus biasing the process toward negative assessments and punitive actions toward drivers. One approach used successfully by this safety director is to post listings of drivers from best to worst in safety performance along various measures; this seems to motivate drivers to move up the list.

OBSM is also addressed in Chapter 5 of this report, as part of behavioral safety management.

4.9 FATIGUE MANAGEMENT PROGRAMS

As noted in Chapter 3, the topic of commercial driver fatigue has probably received greater public attention than any other CMV safety issue in recent years. Much of this attention has focused on the role of fatigue in truck and bus crashes, commercial driver HOS, or other issues beyond the scope of this report. The focus here is on fatigue management practices within fleets and within the context of current HOS and other regulations.

Motor carrier scheduling and dispatching practices have a pronounced impact on driver vulnerability to fatigue. A study

of scheduling practices conducted by the ATAF, with funding support from FHWA OMC (1999; also see Crum, Morrow, and Daecher 2002) developed a model to identify various scheduling-related factors that influence driver fatigue. Key factors included regularity of scheduling, opportunities for quality rest, and "trip control"—the degree to which drivers believed they could plan and execute the trip based on their own rest needs. Economic pressures, such as scheduling demands of customers and driver desire to maximize mileage and pay, were also factors determining level of fatigue. The study recommended that carriers and drivers be mindful of these factors while scheduling trips, beginning perhaps with improved communication between drivers and dispatchers regarding the fatigue implications of schedules.

"Alertness friendly" scheduling is one of the components of comprehensive fatigue management programs (FMPs). Such scheduling takes sleep needs and circadian rhythms into consideration during dispatching, and also empowers drivers to adjust schedules, without recrimination, when sleep needs dictate. Another FMP component is medical screening, counseling, and treatment for sleep disorders, in particular sleep apnea. A third major component is fatigue education, both for drivers and for carrier managers. An emerging trend in CMV safety is the application of systematic FMPs that employ these and other safety interventions. In Canada, a recommended practice for an integrated North American FMP is under development and testing in Alberta, sponsored by Alberta Transportation, Transport Canada, and a number of other government and industry organizations. The FMCSA is also supporting this initiative and its dissemination in the U.S. The fleet-based FMP incorporates improved scheduling practices, medical evaluation (emphasizing sleep apnea screening), and fatigue and wellness education. As noted in Chapter 3, driver health and wellness is an important safety problem that relates directly to alertness and performance. This program will be developed into a complete and packaged FMP program that can be implemented by CMV fleets throughout North America, perhaps in collaboration with government and industry associations. A possible future enhancement to FMPs will be the use of fatigue management technologies (e.g., the actigraph "sleep watch" or in-vehicle alertness monitoring). The actigraph can provide feedback on amount of sleep and, more important, a prediction of alertness based on sleep-wakefulness models (Balkin et al. 2000). In-vehicle alertness monitors employing PERCLOS (or other measures of proven validity) hold the promise of providing warnings to drowsy drivers (Mallis et al. 2000) or "alertometer" feedback or both to help drivers make healthier decisions regarding their sleep and rest needs (Knipling 1998; Knipling and Olsgard 2000).

The ATAF, with support from the FHWA OMC, developed a CMV driver fatigue education program to support fleet-based education in fatigue, whether provided as part of an FMP or separately. The multimedia instructional program includes a manual and video for drivers, and a train-the-trainer program for fleet safety managers.

A fatigue management product developed for the transit industry might also be applicable to CMV transport. The *Toolbox for Transit Operator Fatigue* (Gertler et al. 2002) was developed under TRB's Transit Cooperative Research Program. The publication documents principles, techniques, and strategies for transit driver fatigue mitigation programs. It includes a basic tutorial on human fatigue, recommended management practices, and specific tools that can be used by transit operators. These tools include aids to help predict degree of fatigue; tips for healthy sleep, including naps; self-tests for fatigue and sleep disorders; scheduling guidelines to minimize fatigue; and many other items. A similar product adapted for long-haul and other CMV driving would provide safety managers and drivers with a guide for implementing various fatigue management techniques.

In the I-95 Corridor Coalition Coordinated Safety Management survey (Stock 2001), 51% of fleets indicated that they train drivers in fatigue management techniques. It is likely this percentage will increase in coming years, and that instruction will become more extensive and in-depth, with the greater availability of fatigue management education materials and the emergence of FMPs.

The FMCSA/UM Survey of Safest Motor Carriers (Corsi and Barnard 2003) reported that 74% of its respondents agreed with the statement, "Our drivers refuse dispatches if they don't feel alert." A high majority also permit drivers flexibility in taking rest breaks.

The project survey included two related items, as follows:

Method 13. Improved communication between drivers and dispatchers regarding scheduling and dispatching to prevent fatigue.

		Effectiveness Rating		"Top Five" Selections	
Respondent Type	% Who Use	Mean	Rank (of 28)	% of Respondents	Rank (of 28)
Safety Managers	**72%**	**3.97**	**12**	**35%**	**5**
Other Experts		**4.07**	**8**	**33%**	**4**

Method 14. Fatigue management programs (i.e., employing fatigue education, sleep disorder screening [e.g., sleep apnea], and "fatigue conscious" scheduling and dispatching).

Respondent Type	% Who Use	Effectiveness Rating		"Top Five" Selections	
		Mean	Rank (of 28)	% of Respondents	Rank (of 28)
Safety Managers	**43%**	**3.85**	**18**	**23%**	**13**
Other Experts		**4.11**	**7**	**38%**	**2**

It may be hard to interpret these results, because both items may have meant different things to different respondents. Regarding Method 14 (FMPs), it's likely that respondents were answering in relation to one or more of the specific practices listed, since very few fleets are known to have comprehensive FMPs as envisioned by the North American FMP and similar initiatives. The survey results also indicate that other experts have higher assessments of the effectiveness of these fatigue interventions than do safety managers.

One safety manager respondent suggested that scheduling and communications between dispatchers and drivers can be improved if specific dispatch-related topics are highlighted for discussion at regular safety meetings. Another suggested educating drivers' families on fatigue and the sleep hygiene needs of drivers so that families are more understanding of drivers' needs for sleep and rest when they are at home between runs. One other expert respondent noted the challenge drivers face in obtaining good sleep in sleeper berths or other less-than-ideal sleep environments.

4.10 FLEET-BASED MEDICAL PROGRAMS

The discussion of driver health and wellness problems in Chapter 3 demonstrated their importance, both as measured by health statistics and as assessed by respondents. Recall that both fleet safety managers and other experts rated lifestyle and general health to be among the top safety problems. Fleet-based medical and wellness programs address these problems, and many large corporations in other industries have elaborate health and wellness programs for their workers. The programs often include regular health screenings for workers and follow-up support programs to address specific medical conditions as well as general health and lifestyle issues, such as diet and exercise. Roberts and York (2000) could find few motor carriers who offered such comprehensive programs for their drivers.

Fleets may offer some medical and wellness services to their drivers, however, and there has been a recent initiative to make introductory health and wellness instruction available to carrier safety managers and drivers. The ATAF, working with the National Private Truck Council (NPTC) and with funding from FMCSA, has developed a "Gettin' in Gear" multimedia driver wellness program (FMCSA 2000; Roberts and York 2000). This program includes audio tapes and workbooks for drivers focusing on four aspects of health and wellness:

- Refueling: healthy eating habits;
- Relating: relationships with family and friends;
- Rejuvenating: exercise; and
- Relaxing: managing stress.

The survey included the following two items:

Method 15a. Medical screening/counseling (e.g., sleep apnea, cardiovascular).

Respondent Type	% Who Use	Effectiveness Rating		"Top Five" Selections	
		Mean	Rank (of 28)	% of Respondents	Rank (of 28)
Safety Managers	**38%**	**3.88**	**17**	**12%**	**25**
Other Experts		**3.91**	**13**	**15%**	**13**

Method 15b. General health and wellness instruction/counseling.

Respondent Type	% Who Use	Effectiveness Rating		"Top Five" Selections	
		Mean	Rank (of 28)	% of Respondents	Rank (of 28)
Safety Managers	**37%**	**3.46**	**27**	**7%**	**28**
Other Experts		**3.68**	**19**	**9%**	**21**

More than one-third of responding fleets claimed to have such programs, but generally they were not rated among the most effective methods by safety managers. Other expert evaluations were somewhat higher. One safety manager pointed out that many drivers are starting at "square one" in relation to health and fitness, and that programs in this area need to start with the basics and not expect rapid or dramatic changes in driver attitudes and behavior. The issue of driver health and wellness, and related fleet wellness programs, are discussed in more detail in Chapter 5 as a major potential opportunity area for enhanced carrier safety management.

Method 16a. Regularly scheduled vehicle inspection and maintenance.

Respondent Type	% Who Use	Effectiveness Rating		"Top Five" Selections	
		Mean	Rank (of 28)	% of Respondents	Rank (of 28)
Safety Managers	**91%**	**4.35**	**1**	**40%**	**3**
Other Experts		**4.07**	**8**	**13%**	**15**

Method 16b. Trip sheets (driver documentation of pre- and post-trip maintenance inspections).

Respondent Type	% Who Use	Effectiveness Rating		"Top Five" Selections	
		Mean	Rank (of 28)	% of Respondents	Rank (of 28)
Safety Managers	**87%**	**3.76**	**23**	**11%**	**26**
Other Experts		**3.57**	**22**	**4%**	**28**

4.11 VEHICLE MAINTENANCE AND INSPECTION

SafeReturns (ATAF 1999a) notes that proper vehicle maintenance is considered fundamental by safety-conscious fleets. This includes compliance with federal and state requirements for pre-trip, post-trip, and annual vehicle inspections. Of course, most companies maintain in-house shops for minor repairs and routine maintenance. Smaller firms may contract for such services, however. Many companies develop checklists for pre- and post-trip inspections and schedules for regular preventive maintenance. As noted earlier under training, nearly all safety-conscious fleets train their drivers in equipment inspection, including specific company procedures.

To ensure regular maintenance, many leading companies now use computerized equipment maintenance management programs. These programs are used to collect data and organize data on mechanical failures, and to monitor and schedule preventive maintenance and repairs. In the FMCSA/UM Survey of Safest Motor Carriers (Corsi and Barnard 2003), 56% of respondents reported using such programs. This percentage varied sharply by fleet size, that is, 78% for large fleets versus 23% for small fleets. Prescribed schedules for various maintenance tasks vary; for example, Corsi and Barnard found that about one-half of their responding firms performed routine trailer brake maintenance at regular intervals of 10,000 mi or less.

Appendix E contains safety management job aid addressing vehicle preparation for winter weather. The job aid is provided in both English and French. The project survey included two items on maintenance and inspection:

Safety managers gave Method 16a the No. 1 effectiveness rating of the 28 safety solutions. The other experts rated it closer to the middle of the solution set distribution. Method 16b received much lower ratings. Perhaps this specific practice is regarded as less important than the broader fleet program for vehicle inspection and maintenance.

4.12 VEHICLE SAFETY EQUIPMENT

All new commercial vehicles—both power units and trailers—must meet certain federal motor vehicle safety standards. But, beyond compliance with these standards, buyers of new commercial vehicles have a great deal of discretion in the specific safety-related vehicle components they select for their vehicles. Many large, successful fleets replace their power units on a scheduled basis, for example, every 5 years. Buyers may specify different engine performance specifications (e.g., maximum cruising speeds), on-board recorders and "black boxes," different types of brakes and brake adjusters, tires, mirrors, turn signal configurations, and other components relevant to safe operations. Buyers of trailers may purchase different numbers and patterns of conspicuity lighting and reflectors although, as noted, certain minimum federal requirements apply.

In the past decade, various advanced technology collision avoidance systems have been designed, developed, tested, and marketed. Perhaps the best-known and widely deployed of these are forward collision warning systems. One vendor advertises crash reductions of 35% or more for its users. Other advanced technologies under development, and in some cases marketed, include adaptive cruise control systems (often in combination with forward collision warning), side collision warning systems (to prevent encroachment onto adjacent vehicles during lane changes), roll stability advisors and controllers, and lane tracking systems that advise of overall lane tracking quality (a measure of driver alertness and overall performance) and provide lane departure warnings. Advanced on-board sensor systems can provide diagnostic monitoring of safety-critical components such as brakes and tires. These advanced technology devices may be purchased factory-installed on new vehicles or may be purchased in the after-market for retrofit.

The survey contained one question related to basic safety-related equipment and one to advanced technology systems as equipment options on new vehicles:

4.13 SAFETY MANAGEMENT PROFESSIONALISM

Top management commitment to safety is often cited as an essential element in fleet safety. In *SafeReturns* (ATAF 1999a), 91% of respondents rated "top management commitment" as very important to safety performance. A similar high percentage was seen in the I-95 Corridor Coalition Carrier Safety Management project (Stock 2001). But what are some specific practices that demonstrate top management commitment and effectively implement safety policies?

The project survey contained several items related to safety management professionalism; that is, establishment of specific safety policies and procedures, and systematic efforts to implement and enforce them. This often includes empowering fleet safety managers with sufficient authority to ensure "operational discipline" and to implement fleet-wide systematic programs (e.g., preventive maintenance, defensive driving training, fatigue management, health and wellness, behavioral safety management) that can support long-term and continuous improvements in fleet safety. According to

Method 17a. Basic safety-related equipment (e.g., engine specs, conspicuity lighting).

		Effectiveness Rating		"Top Five" Selections	
Respondent Type	% Who Use	Mean	Rank (of 28)	% of Respondents	Rank (of 28)
Safety Managers	**88%**	**3.97**	**12**	**14%**	**20**
Other Experts		**3.71**	**18**	**5%**	**24**

Method 17b. Advanced technology collision avoidance systems (e.g., forward/rear obstacle detection).

		Effectiveness Rating		"Top Five" Selections	
Respondent Type	% Who Use	Mean	Rank (of 28)	% of Respondents	Rank (of 28)
Safety Managers	**16%**	**3.48**	**26**	**14%**	**20**
Other Experts		**3.68**	**19**	**13%**	**15**

These results imply that safety managers value the importance of basic safety equipment specifications, but otherwise respondents did not place a high value on such safety features, relative to other safety management practices. In particular, fleet safety managers do not appear to believe in the effectiveness of advanced technology safety systems. One respondent, a former safety manager, said the most useful advanced technology was adaptive cruise control, because it "can be effective in offsetting the negatives associated with cruise control in a CMV."

SafeReturns (ATAF 1999a), the fleet safety function should be closely aligned with company decision-making authority for such actions as hiring, training, firing, other discipline, benefits, and compensation.

One approach to achieving such management professionalism is to obtain third-party evaluations and certifications, either of a company's overall system or of managers' individual credentials and knowledge. The project team found a number of examples of third-party certification programs that evaluate fleet safety practices and certify their quality, often

through an iterative process that results in substantial additional improvements in fleet safety. For example, CSA International (2002) has reported case studies in which companies undergoing safety evaluation and certification were able to achieve major reductions in out-of-service rates as part of the process. Such reductions, and the associated safety quality certification, are a source of pride and positive public image for fleets, and also can lead to tangible benefits such as reduction of insurance premiums. Safety management professionalism, including fleet safety certification, is presented in Chapter 5.

Appendix E contains a safety supervisor "report card" developed and used by a commercial carrier. It is designed to ensure that all fleet safety managers engage in specific, prescribed practices.

Below are responses to three survey questions relating to company organization of the safety function and certification of fleet safety practices and safety managers:

Method 18. Within carrier management, alignment of operational and safety functions (e.g., the safety manager is also a direct supervisor).

		Effectiveness Rating		"Top Five" Selections	
Respondent Type	% Who Use	Mean	Rank (of 28)	% of Respondents	Rank (of 28)
Safety Managers	**59%**	**4.10**	**7**	**34%**	**6**
Other Experts		**3.89**	**14**	**23%**	**8**

Method 19a. [Quality] certification of carrier safety management practices.

		Effectiveness Rating		"Top Five" Selections	
Respondent Type	% Who Use	Mean	Rank (of 28)	% of Respondents	Rank (of 28)
Safety Managers	**36%**	**3.85**	**18**	**15%**	**17**
Other Experts		**3.73**	**17**	**13%**	**15**

Method 19b. [Quality] certification of individual fleet safety managers (i.e., professional certificate).

		Effectiveness Rating		"Top Five" Selections	
Respondent Type	% Who Use	Mean	Rank (of 28)	% of Respondents	Rank (of 28)
Safety Managers	**36%**	**3.96**	**14**	**15%**	**17**
Other Experts		**3.64**	**21**	**5%**	**24**

Alignment of operational and safety functions received moderate-to-high ratings by both fleet safety managers and other experts. For both groups, it scored higher in the "Top 5" rankings, indicating that some respondents strongly endorsed the effectiveness of this solution. Neither certification item (19a and 19b) scored highly for either respondent group, perhaps a reflection of the fact that these methods are not well known or widespread in the industry. One other expert respondent noted that carrier safety management certification is an opportunity for the company and all its managers to examine their comprehensive safety program and how all the specific practices combine to create a total system supporting safety. Other respondents noted the value of safety and management training for fleet managers and others in management roles, such as dispatchers and trainers. One safety manager respondent from a large company suggested that specific safety-related duties be established for various levels of fleet management.

One other expert respondent supported quality certification of carrier safety management practices, but expressed the concern that, in some cases, it was a "paper" exercise rather than reflective of actual practices. Another concern, expressed by a safety manager respondent, was that companies may not encourage their managers to obtain such training and certification for fear that it will make more marketable professionally and thus more likely to leave the company.