

Commercial Truck and Bus Safety

Synthesis 1

Effective Commercial Truck and Bus Safety Management Techniques

A Synthesis of Safety Practice

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COMMERCIAL TRUCK AND BUS SAFETY SYNTHESIS PROGRAM

Safety is a principal focus of government agencies and private-sector organizations concerned with transportation. The Federal Motor Carrier Safety Administration (FMCSA) was established within the Department of Transportation on January 1, 2000, pursuant to the Motor Carrier Safety Improvement Act of 1999. Formerly a part of the Federal Highway Administration, the FMCSA's primary mission is to prevent commercial motor vehicle-related fatalities and injuries. Administration activities contribute to ensuring safety in motor carrier operations through strong enforcement of safety regulations, targeting high-risk carriers and commercial motor vehicle drivers; improving safety information systems and commercial motor vehicle technologies; strengthening commercial motor vehicle equipment and operating standards; and increasing safety awareness. To accomplish these activities, the Administration works with federal, state, and local enforcement agencies, the motor carrier industry, labor, safety interest groups, and others. In addition to safety, security-related issues are also receiving significant attention in light of the terrorist events of September 11, 2001.

Administrators, commercial truck and bus carriers, government regulators, and researchers often face problems for which information already exists, either in documented form or as undocumented experience and practice. This information may be fragmented, scattered, and undervalued. As a consequence, full knowledge of what has been learned about a problem may not be brought to bear on its solution. Costly research findings may go unused, valuable experience may be overlooked, and due consideration may not be given to recommended practices for solving or alleviating the problem.

There is information available on nearly every subject of concern to commercial truck and bus safety. Much of it derives from research or from the work of practitioners faced with problems in their day-to-day work. To provide a systematic means for assembling and evaluating such useful information and to make it available to the commercial truck and bus industry, the Commercial Truck and Bus Safety Synthesis Program (CTBSSP) was established by the FMCSA to undertake a series of studies to search out and synthesize useful knowledge from all available sources and to prepare documented reports on current practices in the subject areas of concern. Reports from this endeavor constitute the CTBSSP Synthesis series, which collects and assembles the various forms of information into single concise documents pertaining to specific commercial truck and bus safety problems or sets of closely related problems.

The CTBSSP, administered by the Transportation Research Board, began in early 2002 in support of the FMCSA's safety research programs. The program initiates three to four synthesis studies annually that address concerns in the area of commercial truck and bus safety. A synthesis report is a document that summarizes existing practice in a specific technical area based typically on a literature search and a survey of relevant organizations (e.g., state DOTs, enforcement agencies, commercial truck and bus companies, or other organizations appropriate for the specific topic). The primary users of the syntheses are practitioners who work on issues or problems using diverse approaches in their individual settings. The program is modeled after the successful synthesis programs currently operated as part of the National Cooperative Highway Research Program (NCHRP) and the Transit Cooperative Research Program (TCRP).

This synthesis series reports on various practices, making recommendations where appropriate. Each document is a compendium of the best knowledge available on measures found to be successful in resolving specific problems. To develop these syntheses in a comprehensive manner and to ensure inclusion of significant knowledge, available information assembled from numerous sources, including a large number of relevant organizations, is analyzed.

For each topic, the project objectives are (1) to locate and assemble documented information; (2) to learn what practice has been used for solving or alleviating problems; (3) to identify all ongoing research; (4) to learn what problems remain largely unsolved; and (5) to organize, evaluate, and document the useful information that is acquired. Each synthesis is an immediately useful document that records practices that were acceptable within the limitations of the knowledge available at the time of its preparation.

The CTBSSP is governed by a Program Oversight Panel consisting of individuals knowledgeable in the area of commercial truck and bus safety from a number of perspectives—commercial truck and bus carriers, key industry trade associations, state regulatory agencies, safety organizations, academia, and related federal agencies. Major responsibilities of the panel are to (1) provide general oversight of the CTBSSP and its procedures, (2) annually select synthesis topics, (3) refine synthesis scopes, (4) select researchers to prepare each synthesis, (5) review products, and (6) make publication recommendations.

Each year, potential synthesis topics are solicited through a broad industry-wide process. Based on the topics received, the Program Oversight Panel selects new synthesis topics based on the level of funding provided by the FMCSA. In late 2002, the Program Oversight Panel selected two task-order contractor teams through a competitive process to conduct syntheses for Fiscal Years 2003 through 2005.

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The following organizations provided more extensive support, either by scheduling focus groups, participating in interviews, providing research reports, providing sample safety management tools (see Appendix E), and coordinating the distribution and collection of safety manager survey forms:

- American Bus Association
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- Colorado Department of Transportation
- Colorado Motor Carriers Association
- Contract Freighters, Inc.
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- Flood and Peterson Insurance
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- National Association of Small Truck Companies
- National Industrial Transportation League
- National Private Truck Council
- Praxair Distribution, Inc.
- TRB Truck and Bus Safety Research Task Force (A3B57)
- Truckload Carriers Association
- Virginia Trucking Association
- Zurich Services Corporation

FOREWORD

*By Christopher W. Jenks
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This synthesis, the first in the CTBSSP series, will be of use to commercial truck and bus carriers and others interested in improving commercial vehicle safety. It provides a useful summary of practice in the area of commercial truck and bus safety management techniques. The synthesis focuses on the problems fleet managers confront and the methods that are available to address these problems. Twenty discrete safety problems and 28 safety management methods are identified. Problems addressed encompass driver-safety knowledge, skills, alertness, physical/medical condition, attitudes, and driving behaviors. In addition, several vehicle-related problem areas, including vehicle maintenance and inspection, are discussed. Major safety management approaches addressed include driver recruiting and selection, carrier-based training, management-driver communications, driver safety-performance evaluation, safety incentives, behavior-based safety, on-board safety monitoring, event-data recorders, accident investigation, improved driver scheduling and dispatching, fatigue management, carrier-based medical programs, preventive maintenance and vehicle inspection, advanced safety technologies, and industry-based safety standards and certification. The synthesis is based on a review of relevant literature, as well as a survey of commercial motor vehicle safety managers (139 respondents) and other experts in motor carrier safety (57 respondents).

Administrators, commercial truck and bus carriers, government regulators, and researchers often face problems for which information already exists, either in documented form or as undocumented experience and practice. This information may be fragmented, scattered, and undervalued. As a consequence, full knowledge of what has been learned about a problem may not be brought to bear on its solution. Costly research findings may go unused, valuable experience may be overlooked, and due consideration may not be given to recommended practices for solving or alleviating the problem.

There is information available on nearly every subject of concern to commercial truck and bus safety. Much of it derives from research or from the work of practitioners faced with problems in their day-to-day jobs. To provide a systematic means for assembling and evaluating such useful information and to make it available to the commercial truck and bus industry, the Commercial Truck and Bus Safety Synthesis Program (CTBSSP) was established by the Federal Motor Carrier Safety Administration (FMCSA) to undertake a series of studies to search out and synthesize useful knowledge from all available sources and to prepare documented reports on current practices in selected areas of concern. Reports from this endeavor constitute the CTBSSP Synthesis series, which collects and assembles information into single concise documents pertaining to specific commercial truck and bus safety issues.

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This synthesis series reports on various practices; each document is a compendium of the best knowledge available on measures found to be successful in resolving specific problems. To develop these syntheses in a comprehensive manner and to ensure inclusion of significant knowledge, available information assembled from numerous sources is analyzed.

For each topic, the project objectives are (1) to locate and assemble documented information; (2) to learn what practice has been used for solving or alleviating problems; (3) to identify all ongoing research; (4) to learn what problems remain largely unsolved; and (5) to organize, evaluate, and document the useful information that is acquired. Each synthesis is an immediately useful document that records practices that were acceptable within the limitations of the knowledge available at the time of its preparation.

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EFFECTIVE COMMERCIAL TRUCK AND BUS SAFETY MANAGEMENT TECHNIQUES

SUMMARY

This research project focuses on motor carrier (large truck and bus) fleet safety management: the problems fleet managers confront and the methods that are available to address these problems. Based on the knowledge and experience of the authors, a literature review, discussions and interviews with experts, and suggestions from the TRB synthesis panel, 20 discrete safety problems and 28 safety management methods were identified. Problems addressed encompass driver-safety knowledge, skills, driving behaviors, alertness, physical/medical condition, and attitudes. In addition, several vehicle-related problem areas, such as vehicle maintenance and inspection, were considered. Major safety management approaches addressed include those relating to driver recruiting, selection, carrier-based training, management-driver communications, driver safety-performance evaluation, safety incentives, behavior-based safety (BBS), on-board safety monitoring (OBSM), event-data recorders, accident investigation, improved driver scheduling and dispatching, fatigue management, carrier-based medical programs, preventive maintenance and vehicle inspection, advanced safety technologies, and industry-based safety standards and certification.

Much of the information for the study was collected through survey questionnaires from fleet safety managers and other experts in motor carrier safety. Safety manager surveys were distributed primarily through industry trade associations (e.g., to their safety council members). Thus, the sample is biased toward safety-conscious managers. The “other expert” survey was distributed through professional organizations, to attendees at recent motor carrier safety conferences, and to colleagues of the authors.

Two parallel survey forms were used: one for current Commercial Motor Vehicle (CMV) fleet safety managers (139 respondents) and one for other experts in motor carrier safety (57 respondents). The 20 specific problem areas and 28 specific safety management solutions (i.e., practices) listed were identical on the two forms. For the problem areas, respondents were asked to rate the relative importance of the areas on a 5-point scale, and then to identify the five most important problem areas. Safety managers were asked to respond in relation to their own fleets; other experts were asked to respond in relation to commercial vehicle operations (CVO) in general. For the 28 solutions, safety managers were first asked to indicate “yes” or “no” whether they currently used the safety management method with their fleets. If “yes,” they rated the effectiveness

of the method in their fleet using the same 5-point scale, and then selected the five most effective methods. For the other experts, there was no “yes” or “no” question; instead, they simply rated each method in terms of its general effectiveness in carrier safety management and selected their “Top 5” methods.

The survey results are presented in Chapters 3 and 4 on safety management problem areas and methods, respectively. For the problem areas, the key question was “importance.” For the methods, it was “effectiveness.” For each of the 20 problem areas and 28 methods, a short discussion is provided, including major findings from the literature, and the survey results are shown. Both mean ratings and rankings are provided, as well as selected comments by respondents. To supplement the safety management methods discussion, 16 safety management “tools” or job aids are provided (courtesy of various contributors) in Appendix E.

The following were the most important safety problems for fleet safety manager respondents, based on their mean 5-point scale ratings:

1. At-risk driving behaviors (e.g., speeding, tailgating);
2. High-risk drivers (all causes combined);
3. Driver health and wellness, lifestyle, and general health;
4. Lack of defensive driving skills;
5. Delays associated with loading and unloading (resulting in long working hours);
6. Driver fatigue/drowsiness; and
7. Aggressive driving (“road rage”).

The following were the most important safety problems for other expert respondents, based on their mean ratings:

1. High-risk drivers (all causes combined);
2. Driver fatigue/drowsiness;
3. At-risk driving behaviors (e.g., speeding, tailgating);
4. Delays associated with loading and unloading (resulting in long working hours);
5. Driver turnover resulting in unstable workforce;
6. Driver health and wellness, lifestyle, and general health [tie]; and
7. Sleep apnea [tie].

These were the most widely practiced methods, per the safety managers:

1. Continuous tracking of drivers’ crashes/incidents/violations: 92%;
2. Regularly scheduled vehicle inspection and maintenance: 91%;
3. Hiring based on criteria related to driver crash, violation, or incident history: 90%;
4. Tracking of overall fleet safety statistics (e.g., crash/violation rate): 88% [tie];
5. Safety-related basic equipment specifications on new vehicles: 88% [tie];
6. Standardized training for all new hires: 87% [tie]; and
7. Trip sheets (e.g., driver documentation of pre- and post-trip inspections: 87% [tie].

The following were the most effective safety methods for fleet safety manager respondents, based on their mean ratings:

1. Regularly scheduled vehicle inspection and maintenance;
2. Hiring based on criteria related to driver crash, violation, or incident history;
3. Continuous tracking of drivers’ crashes/incidents/violations;

4. Requiring that new hires meet or exceed a minimum number of years of driving experience;
5. Crash and incident investigation by carrier management;
6. Standardized training for all new hires; and
7. Within carrier management, alignment of operational and safety functions.

The following were the most effective safety management methods for the other expert respondents, based on their mean ratings:

1. Continuous tracking of drivers' crashes/incidents/violations;
2. Hiring based on criteria related to driver crash, violation, or incident history [tie];
3. Apprenticeship and "finishing" programs for new drivers [tie];
4. Standardized training for all new hires [tie];
5. Regular refresher training for all drivers [tie];
6. Remedial training programs for problem drivers; and
7. Fatigue management programs.

As one safety manager respondent pointed out, effective carrier safety management "is not one thing—it's many things." There are many different safety problems to be addressed and many worthwhile management techniques that can contribute to enhanced fleet safety.

The project team selected four study topics for more in-depth discussion; they are regarded by the project team as areas of great safety opportunity for truck and bus transportation. For all four topics, the research literature and other information about the industry indicate that significant safety gains are possible by focusing on the issue or employing the safety management methodology. The four issues are (1) driver health, wellness, and lifestyle; (2) high-risk drivers; (3) behavioral safety management; and (4) safety management professionalism.

The first two of these issues are problem areas receiving high importance ratings in the survey and for which there is also strong research evidence and industry consensus, highlighting their importance. The second two are general approaches to improved safety management, both of which involve various specific techniques. Although these methods were not frequently practiced by safety manager respondents nor rated among the most effective methods in the survey, there is much scientific literature and other rationales to indicate they could have a significant positive impact on the CMV industry if employed.

These four topics (and others) provide many research and development (R&D) needs and opportunities for government, industry, and academia. A common theme of this discussion of R&D needs is that motor carrier safety management must be elevated to a mature science which conducts sophisticated studies to elucidate and quantify risk factors, develops more innovative and comprehensive methods, and experimentally compares and evaluates these methods in fleet-based safety intervention studies.

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

This synthesis is a review and survey of Effective Commercial Truck and Bus Safety Management Techniques. Motor carrier safety management involves a number of diverse practices ranging from equipment management (e.g., preventive maintenance) to driver-safety incentive programs. This synthesis study identifies major safety management problems of concern to motor carrier safety managers and other industry experts. More important, it describes available approaches to enhanced safety, cites evidence for their effectiveness, and generates hypotheses for new R&D on commercial truck and bus fleet safety management practices.

A rich body of scientific literature exists regarding military and industrial safety management practices. In the U.S. military, these practices have been formalized as various military standards. In industry, there is a major discipline called “system safety.” Unfortunately, such an extensive body of literature does not exist relating to the management of CMV operations and drivers, even though truck driving is the most hazardous U.S. occupation, more than 5,000 fatalities occur annually in truck crashes, and per-vehicle crash costs for tractor-trailers are more than four times those of other vehicle types.

Most CMV safety managers are former drivers who have come up “through the ranks” to a management position. Many progressed from being independent owner-operators to owning and managing their own fleet. Safety, proficiency, and productivity as a driver are likely to be factors that enable these individuals to progress to fleet ownership or a management position. The lessons they have learned on the job are applied to their management of others. However, most CMV safety managers have not had formal training in management, system safety, or the human factors of driving safety. Thus, their effectiveness as safety managers is likely to vary widely, with gaps in their knowledge of various safety problems or available management solutions. A necessary step toward making such knowledge available to carrier safety managers is the systematic compilation of information relating to CMV safety management and the establishment of a common body of knowledge that would serve as the basis for improved training for managers or other means of disseminating safety management information to them.

A strategic goal identified by the FMCSA in its strategic planning process conducted in 2000 was to “facilitate improvement in the overall safety performance of the motor carrier industry through refined and enhanced safety management systems.” Accordingly, FMCSA’s Research and Technology (R&T) program includes a focus area on “Carrier Compliance and Safety” (FMCSA, 2001). A major goal of this R&T area, in addition to supporting the agency’s enforcement program, is to improve carrier safety by applying principles of safety management from other industries and by compiling best management practices from the motor carrier and other industries and communicating these to motor carrier managers. In a recent FMCSA R&T study called “Driver, Vehicle, and Roadside Strategies for 2010” (FMCSA, 2002), lack of adequate managerial oversight by carriers was cited as one of five high-priority safety problem areas. This synthesis, in addition to directly supporting CMV fleets and industry segments, is intended to assist FMCSA by providing a review of the literature and best practices relating to safety management. The synthesis summarizes various safety management approaches and practices applicable to the management of drivers and vehicles, and generates hypotheses for new research on CMV fleet safety management practices.

1.2 SCOPE

Appendix B contains the Statement of Work (SOW) for the research project. According to this SOW, this research project focuses on safety management issues and approaches applicable to CMV—truck and bus—transportation.

The research project focuses on the “what” and the “how” of CMV safety management. “What” refers to the principal safety issues, problems, or sources of crash risk that must be addressed by CMV safety management practices. This includes deficiencies in driver skill, knowledge, or safety behavior; fatigue and other sources of impairment; physical and medical problems, attitudes, morale, and turnover; vehicle inspection and maintenance; and the problem of high-risk drivers associated with any of these problem areas.

“How” refers to the techniques and approaches employed. Major safety management approaches to be addressed include those relating to driver recruitment, selection, carrier-based training, management-driver communications, driver safety-

performance evaluation, safety incentives, BBS, OBSM, event-data recorders, accident investigation, improved driver scheduling and dispatching, fatigue management, carrier-based medical programs, preventive maintenance and vehicle inspection, advanced safety technologies, and industry-based safety standards and certification. In some cases, there is a one-to-one correspondence between problems and approaches; thus, for example, CMV driver fatigue is addressed as an issue, and fatigue management programs are addressed as safety management approaches. In most cases, however, the techniques and approaches apply to more than one specific safety issue.

Principally, this research project relates to CMV operations that transport cargo or passengers in interstate commerce, and to which the FMCSRs are applicable. However, the synthesis does not primarily address the management of *compliance* with federal and other motor carrier safety regulations. In the research project, regulatory compliance has been viewed as an essential *prerequisite* for safe commercial vehicle operations, but not as sufficient to ensure safe operations. It is assumed that active safety management approaches going *beyond compliance* are necessary to achieve high operational safety.

CMV safety management is a broad and loosely defined topic. This research project is not intended to address the broad spectrum of motor carrier safety issues. In particular, the research project does *not* address government or industry policy issues. Moreover, the following topics are not addressed:

- FMCSA or other federal, state, or local government policy or regulations (beyond discussions of how carriers can achieve better compliance with these regulations).
- Government enforcement programs or other safety programs implemented by government as opposed to being implemented at the carrier level. This includes public information campaigns and roadway design and operational practices.
- The conduct of driver alcohol and/or drug testing or any similar government-mandated safety requirements.
- The technical details of CMV design or vehicle-based safety technologies. Technologies are addressed as tools of safety management, but there are no detailed discussions of the mechanisms or application of specific vehicle design features or technologies.
- Advanced communication and information systems. These technologies are relevant, indeed important, to fleet safety management but involve too many technical and operational issues to address in this research project.
- Commercial driver training, except as may be practiced by a carrier as an adjunct to driver safety management. Thus, carrier-based apprentice and “finishing” approaches are discussed, but entry-level or other school-based CMV driver training is not. A future research project will address best practices for training CMV drivers.

- Non-transportation related operational safety issues, in particular injuries related to cargo loading and unloading, or other loading dock safety or security issues not involving moving vehicles.

1.3 APPROACH

Information on CMV safety problems and solutions was obtained through several major approaches. The primary vehicle for obtaining information was project surveys. Two parallel survey forms were employed: (a) one for current CMV fleet safety managers and (b) one for other experts in motor carrier safety. This synthesis is structured primarily around the survey findings and their implications. Interviews and focus groups were also conducted with key individuals and groups involved in motor carrier safety, including FMCSA and major trade associations.

Supporting the survey and interview findings is information obtained from literature reviews relating to the various topics of CMV safety management. The literature review employed Transportation Research Information System (TRIS) and other reference systems to identify relevant publications in the transportation literature. Also reviewed were FMCSA research publications; American Trucking Associations (ATA) and other industry trade association publications; the traffic safety research literature (e.g., journals such as *Accident Analysis & Prevention*); the industrial safety management literature (e.g., *Journal of Safety Research*, *Journal of Organizational Behavior Management*, *Professional Safety*, *Occupational Health & Safety*); the applied behavioral science literature (e.g., *Journal of Applied Behavior Analysis*, *Journal of Applied Psychology*); proceedings of recent conferences focusing on truck and bus safety (e.g., April 2002 International Truck & Bus Safety Symposium in Knoxville); and the web pages of safety services vendors. A few specific information sources providing extensive information to the project are described below in Section 1.4.

In addition to reporting results from the surveys, literature review, and other information sources, the project team selected four safety issues for more detailed discussion in Chapter 5. The four selected topics are (1) driver health, wellness, and lifestyle; (2) high-risk drivers; (3) behavioral safety management; and (4) safety management professionalism.

These four areas were not necessarily the highest-rated in the surveys, but rather were selected by the project team based on overall consideration of available information. In particular, these areas have received relatively little attention in relation to their apparent importance or potential benefits to the CMV industry. Chapter 5 summarizes project evidence and other literature relating to these areas and offers recommendations for future government, industry, and academic initiatives relating to them.

This synthesis concludes with recommendations for R&D that might be performed to create new knowledge and tools to address specific issues and safety opportunities identified

in the synthesis. Both “research” and “development” are conceived broadly and may include many different types of initiatives undertaken by various parties and stakeholders involved in motor carrier safety.

Appendixes to the report include TRB’s CTBSSP program description and the SOW for this research project. In addition, the two project survey forms are provided. Finally, there is an appendix containing 16 safety management job aids (for managers and drivers) developed by the CMV industry, including trade associations, insurance companies, and fleets. These do not represent a comprehensive set of such job aids needed by carrier safety managers, but they are excellent examples of practical tools that managers can use to enhance the safety of their fleet operations.

1.4 SUMMARY OF SELECTED MAJOR SOURCES

Although the scientific literature relating to CMV safety management is not extensive, there have been several other recent projects that have compiled information on the topic; in particular, on various safety management practices of motor carrier fleets. The following specific information sources relate directly to carrier safety management and are cited frequently in this synthesis. All are recommended to individuals seeking additional information on CMV safety management.

1.4.1 SafeReturns

In 1999, the American Trucking Associations Foundation (ATAF), in conjunction with the Parker-Young Company, published *SafeReturns: A Compendium of Injury Reduction and Safety Management Practices of Award Winning Carriers*. The study (ATAF 1999a, Olsgard 1999) employed case studies, workshops, and surveys involving safety managers. Analysis of the surveys included some comparisons of the responses of safety managers of outstanding fleets to those of a more general sample to identify critical practices. The report reviewed various management “tools for success” (management practices); methods to minimize loading/unloading injury risks (an area not covered by this synthesis); highlights of survey findings; and examples of various safety management tools, such as interview guides and questions relating to fleet safety management programs.

1.4.2 Truck Driver Risk Assessment Guide

The ATAF, in collaboration with the Driver Training and Development Alliance, produced this document (ATAF 1999b) as an aid to carrier safety managers. The FMCSA (then the FHWA Office of Motor Carrier and Highway Safety) supported the project. The full report title is: *Truck*

Driver Risk Assessment Guide and Effective Countermeasures; Recommended Management Practices. The guide is organized into three major parts: Driver Selection, In-Service Performance, and Personal Issues (including at-risk behaviors and health/wellness). Appendixes provide specific tools for improved management, including a structured driver interview form, driving performance standards by driving task, trainee evaluation form, pre- and post-trip vehicle inspection checklists, templates for evaluation letters (positive and corrective) to drivers, employee appraisal form, driver performance evaluation form, summary of an example driver reward/incentive program, sample company policies for accidents and traffic violations, accident reporting and investigation procedures, a summary of BBS principles, fleet guidelines and checklist for alcohol/drug testing, alcohol/drug testing Qs & As, alcohol/drug testing release for information from previous employer, and a sample fleet drug/alcohol policy.

1.4.3 I-95 Corridor Coalition: Best Practices in Motor Carrier Safety Management

The Pennsylvania Department of Transportation, through the Pennsylvania Transportation Institute of Pennsylvania State University conducted several studies on carrier safety management which were completed in August 2001. Two related studies were especially relevant to this research project.

Volume I of the series (Stock, 2001) addressed best practices in motor carrier safety management by conducting a survey of state motor carrier association members in several Northeastern states. The nearly 600 respondents to the survey were considered to represent a sample of the best safety performers. The survey addressed the importance of various safety programs to overall fleet safety; examples included driver hiring criteria, driver retention, in-house and outside training, top management commitment, safety meetings and awareness programs, safety incentive programs, driver monitoring, and accident review.

Volume IV of the series (Stock, Rood, and Hammer 2001) developed, pilot tested, and evaluated motor carrier safety education/outreach materials for safety managers. Specific products developed included a 3-hour seminar, a brochure highlighting frequently-used management practices of safe carriers, and an interactive, web-based “safety toolbox” (<http://safetytoolbox.uconn.edu>) to allow motor carriers to benchmark their safety management practices against the 600 survey respondents, who generally represented top carriers.

1.4.4 FMCSA/UM Survey of Safest Motor Carriers

Under the sponsorship of the FMCSA, the University of Maryland (UM) Supply Chain Management Center of The

Robert H. Smith School of Business conducted a survey of “best safety performers” to identify and define their safety management programs and policies (Corsi and Barnard 2003). The survey was conducted in 2002, concurrently with the present research project. The study addressed many of the same safety management practices addressed in this report, and its findings are cited extensively in Chapter 4 of this synthesis. Corsi and Barnard identified safety performance leaders through a two-step process, which included review of Safe-Stat performance data and recommendations from FMCSA State Safety Directors. An extensive survey was completed by 148 safe carriers and formed the basis for their report. Their study will be used by FMCSA to support various motor carrier safety programs, including the “Safety is Good Busi-

ness” outreach program to carriers, which is currently under development.

The FMCSA/UM study included some general questions on the importance carriers place on safety management issues. Many of their respondents believed, for example that carrier safety management involves more than just compliance with public safety regulations. The majority agreed (at various levels of agreement) with the statement that “Cost is no issue when it comes to highway safety decisions at our company.” There was strong agreement with the idea that “customer service and highway safety performance go hand-in-hand.” These core safety values are reflected in various specific safe carrier management practices identified in their report and also addressed in the research project.

CHAPTER 2

CARRIER SAFETY MANAGEMENT SURVEY

2.1 SURVEY METHODOLOGY

The primary vehicle for obtaining information in this research project was surveys. Two parallel survey forms were employed: (a) one for current CMV fleet safety managers and (b) one for other experts in motor carrier safety. These are provided in Appendixes C and D, respectively. This section describes the survey methodology in more detail, and the next section of this chapter provides principal results.

The 20 specific problem areas and 28 specific safety management solutions (i.e., practices) listed were identical on the two forms. For the problem areas, respondents were asked to rate the relative importance of the areas on a 5-point scale, and then to identify the five most important problem areas. Safety managers were asked to respond in relation to their own fleets; other experts were asked to respond in relation to CVO in general. Both the rating scale (1–5) and “Top 5” selection choices were employed to make the results more discriminative among the 20 problem areas. For example, if a respondent rated more than five problem areas as “5,” he or she still had to select which five of the 20 items were most important. Both safety managers and other experts were instructed to answer the problem items in relation to CMV drivers, not in relation to drivers in general.

For the 28 solutions, safety managers were first asked to indicate “yes” or “no” whether they currently used the safety management method with their fleets. If “yes,” they rated the effectiveness of the method in their fleet using the same 5-point scale, and then selected the five most effective methods. Again, the purpose of using both ratings and rankings was to increase the sensitivity of the results. For the other experts, there was no “yes” or “no” question; instead, they simply rated each method in terms of its general effectiveness in carrier safety management and selected their “Top 5” methods.

In the analysis, the scale ratings were treated as interval scale values. That is, it was assumed that there are equal differences between successive values of the scale (e.g., the difference between 1 and 2 is the same as the difference between 2 and 3, and so forth). There was no verification of this assumption, but it was implicit when means were calculated. Means are likely the most sensitive and valid statistical measure of central tendency for the data, even though the interval scale assumption is unverified.

Each survey form collected some basic respondent information. For safety managers, the form asked questions relating to years of experience, fleet size, and primary fleet operations type (e.g., truckload, less-than-truckload [LTL], motor coach). For other experts, the form asked years of experience and specific experience areas (e.g., government, industry trade association, driver, fleet safety manager, research).

The survey forms were distributed through various organizations (e.g., primarily industry trade associations for safety managers) and professional contacts. For the vast majority of fleets, there was only one respondent per fleet. Nevertheless, it was possible for individual fleets to have more than one respondent; most notably, one company had seven respondents representing safety managers at different company terminals throughout the country. Both samples may be characterized as representing safety-conscious individuals working in the industry or otherwise associated with CVO. For example, most of the participating trade associations distributed the survey to their safety council members only. Attendees (both safety managers and other experts) at several truck and bus safety conferences were also sent survey forms. Of course, those who completed and returned a survey of this nature were probably those most interested in the topic and committed to support efforts relating to it. Study resources did not permit the design of a systematic subject sampling and survey distribution process or the tracking of survey return rates for various respondent groups.

Survey responses were entered by hand into a spreadsheet, which was programmed to tabulate results. All survey responses were confidential and there is no attribution of responses by individual, company name, or other organizational affiliation in this synthesis. Nevertheless, for several trade associations, survey results were tabulated separately for their members and returned to their safety coordinators for their own organizational use. In this report, however, unless otherwise indicated, statistics cited are only for the two major (and separate) respondent groups: fleet safety managers and other experts.

2.2 PRINCIPAL RESULTS

2.2.1 Safety Management Problems

Table 1 provides a summary of the importance ratings and rankings of the 20 CMV safety problem areas addressed by

TABLE 1 Safety management problem areas

PROBLEM AREA:	SAFETY MANAGER				OTHER EXPERTS			
	Importance Rating		“Top 5” Selections		Importance Rating		“Top 5” Selections	
	Mean	Rank (of 20)	%	Rank (of 20)	Mean	Rank (of 20)	%	Rank (of 20)
1. Insufficient training:								
a. Lack of basic driving skills.	2.74	14	17%	12	3.26	17	16%	9
b. Poor knowledge of federal, state, and/or company rules	3.04	12	18%	11	3.30	16	11%	13
2. At-risk driving behaviors (e.g., speeding, tailgating)	3.75	1	55%	1	4.21	3	58%	4
3. Aggressive driving (i.e., “road rage”)	3.26	7	26%	8	3.33	11	14%	11
4. Lack of defensive driving skills (e.g., space management around vehicle)	3.48	4	40%	4	3.58	8	23%	7
5. Driver fatigue/drowsiness	3.37	6	29%	6	4.28	2	67%	2
6. Delays associated with loading and unloading (e.g., resulting in long working hours, tight schedules, and fatigue)	3.45	5	40%	4	4.18	4	60%	3
7. Alcohol and/or illicit drug abuse	1.99	20	2%	20	2.54	20	2%	19
8. Driver health and wellness problems, specifically:								
a. Lifestyle/general health-related (e.g., poor diet, smoking)	3.65	3	46%	2	3.79	6	44%	6
b. Sleep apnea	3.07	11	9%	14	3.79	6	16%	9
c. Cardiovascular illness/heart disease	3.19	8	13%	13	3.32	12	4%	17
d. Prescription drug side effects (e.g., drowsiness)	2.73	16	3%	19	3.32	12	2%	19
e. Mental illness (e.g., depression, anxiety, mood disorders)	2.59	17	4%	17	3.05	19	4%	17
9. Poor attitude and morale, loneliness, alienation, unhappiness	3.16	9	29%	6	3.47	9	14%	11
10. Driver turnover resulting in unstable workforce	2.96	13	23%	10	4.09	5	46%	5
11. Drivers unfamiliar with routes	2.74	14	9%	14	3.32	12	11%	13
12. Neglect of vehicle maintenance (e.g., brakes, tires)	2.36	19	8%	16	3.38	10	18%	8
13. Failure to inspect vehicle (e.g., pre-/post-trip)	3.16	9	24%	9	3.32	12	5%	15
14. Unsecured loads	2.38	18	4%	17	3.23	18	5%	15
15. High-risk drivers [all causes combined] (i.e., the degree to which managers should focus on the worst 10-20% of their drivers)	3.69	2	42%	3	4.43	1	68%	1

the survey. The statistics for safety managers (N = 139) and other experts (N = 57) are presented separately. For each group, four statistics are provided:

- Mean importance rating,
- Rank of importance ratings (i.e., highest average rating = 1),
- Percent of respondents selecting problem as among “Top 5,” and
- Rank of percent selection as among “Top 5” (i.e., highest percentage = 1).

One interesting systematic difference between safety managers and other experts was that the safety managers’ mean importance ratings were generally much lower on the 5-point scale. The overall average importance rating for all 20 items was 3.04 for the safety managers versus 3.56 for the other

experts. All 20 problem items received lower mean ratings from safety managers than from other experts. Recall that safety managers were asked to respond in regard to their own fleet, whereas other experts were asked to respond in relation to CMV safety in general. This seems to parallel the common finding that drivers tend to rate their own driving as much safer than that of drivers in general. An alternative explanation is that, since the safety manager respondents did represent a safety-conscious sample (see Section 2.1), their ratings of their own fleets are an accurate reflection of safer operations. Regardless, this difference is worth remembering when interpreting the results. Comparisons between safety managers and other experts in this synthesis will address their *relative* ratings of the various problems, as opposed to their absolute mean ratings.

Not surprisingly, there were high correlations across the four statistics for the 20 problem areas shown in Table 1.

Although the correlations were high, there were a few notable differences in relative importance ratings. The two largest differences in the relative ratings were as follows (note: lower rankings indicate higher relative importance ratings):

- Driver turnover resulting in unstable workforce (Item 10):
 - Safety managers: rated 13th of 20 problems
 - Other experts: rated 5th of 20 problems
- Neglect of vehicle maintenance (Item 12):
 - Safety managers: rated 19th of 20 problems
 - Other experts: rated 10th of 20 problems.

The various specific findings in Table 1 will be discussed primarily in the context of the individual problem areas (see Chapter 3).

2.2.2 Safety Management Solutions

Table 2 provides a summary of the effectiveness ratings and rankings of the 28 CMV safety solutions (management methods) addressed by the survey. The statistics for safety managers and other experts are presented separately. For safety managers, five statistics are provided:

TABLE 2 Safety management solution areas

SOLUTION AREA:	SAFETY MANAGERS					OTHER EXPERTS			
	Effectiveness Rating			“Top 5” Selections		Effective-ness Rating		“Top 5” Selections	
	% Who Use	Mean	Rank (of 28)	%	Rank (of 28)	Mean	Rank (of 28)	%	Rank (of 28)
1. Safe driver recruiting methods									
a. Requiring that new hires meet or exceed a minimum number of years of driving experience	86%	4.15	4	46%	2	3.55	24	13%	15
b. Hiring based on criteria relating to driver crash, violation, or incident history	90%	4.19	2	53%	1	4.36	2	54%	1
2. Training standards/programs:									
a. Standardized training for all new hires [e.g., company policy & procedures, customer relations, defensive driving skills, rules for driving (e.g., speeding, headway)]	87%	4.11	6	40%	3	4.18	4	32%	5
b. Apprenticeship and “finishing” programs for new drivers, conducted by safety manager or senior driver	51%	4.01	9	15%	17	4.36	2	27%	6
c. Regular refresher training for all drivers	63%	3.94	16	16%	15	4.18	4	24%	7
d. Remedial training programs for problem drivers	69%	3.99	10	14%	20	4.14	6	21%	10
3. Regularly-scheduled safety meetings	75%	3.96	14	31%	8	3.57	22	7%	22
4. Regular safety performance evaluations:									
a. Observation of driving behaviors through ride-alongs	48%	4.07	8	31%	8	3.55	24	13%	15
b. Continuous tracking of driver’s crashes/incidents/violations	92%	4.16	3	24%	12	4.46	1	38%	2
5. Tracking of overall fleet safety statistics (e.g., fleet crash/violation rate)	88%	3.98	11	13%	24	4.00	10	15%	13
6. Driver incentive programs for outcome-based safety measures (i.e., reward for crash-free miles)	73%	3.83	21	28%	10	3.89	14	20%	11
7. Behavior-based safety [i.e., observation, self-observation, feedback, incentives focusing on safety-related driving behaviors (e.g., safety belt use, safe speeds, safe headways)]	59%	3.80	22	14%	20	3.95	12	11%	20
8. On-board computer monitoring devices <i>with</i> management review, feedback and rewards/punishments for good/poor performance	36%	3.85	18	33%	7	3.86	16	22%	9
9. On-board computer monitoring (e.g., speed monitoring) and feedback to drivers <i>without</i> management review	21%	3.09	28	9%	27	3.05	27	5%	24
10. Event-data recorders (“black boxes”) used to reconstruct crashes and incidents	24%	3.59	24	17%	14	3.41	26	7%	22

- Percent who use (“yes/no” response),
- Mean effectiveness rating,
- Rank of effectiveness ratings (i.e., highest average rating = 1),
- Percent of respondents selecting solution as among “Top 5,” and
- Rank of percent selection as among “Top 5” (i.e., highest percentage = 1).

As for the safety problems, safety managers were responding in regard to their own fleets in their effectiveness assessments. They were asked to rate the items on the 5-point effectiveness scale only if they reported “yes” to the yes/no

use question, and the mean effectiveness rating for each item was calculated only for those who rated the item.

The fourth statistic (percent of respondents selecting solution as among “Top 5”) was also calculated by dividing the number of such selections by the number of respondents who rated that item. These statistics were then used to derive the fifth statistic listed (rank of percent selection). Thus, it would be possible for a rarely used method (i.e., not rated by many respondents) to still receive a high ranking, if those who did use the method rated it highly.

For other experts, there was no “yes/no” question, but the remaining four statistics are the same as those for safety managers. The other experts were responding in regard to CVO

TABLE 2 (Continued)

SOLUTION AREA:	SAFETY MANAGERS					OTHER EXPERTS			
	Effectiveness Rating			“Top 5” Selections		Effective-ness Rating		“Top 5” Selections	
	% Who Use	Mean	Rank (of 28)	%	Rank (of 28)	Mean	Rank (of 28)	%	Rank (of 28)
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)	83%	4.13	5	27%	11	4.00	10	18%	12
12. “How’s My Driving” placards and 800 numbers	22%	3.50	25	16%	15	2.61	28	5%	24
13. Improved communication between drivers and dispatchers regarding scheduling and dispatching to prevent fatigue	72%	3.97	12	35%	5	4.07	8	33%	4
14. Fatigue management programs [i.e., employing fatigue education, sleep disorder screening (e.g., sleep apnea), and “fatigue-conscious” scheduling and dispatching]	43%	3.85	18	23%	13	4.11	7	38%	2
15. Fleet-based medical programs:									
a. Medical screening/counseling (e.g., sleep apnea, cardiovascular)	38%	3.88	17	12%	25	3.91	13	15%	13
b. General health & wellness instruction/counseling	37%	3.46	27	7%	28	3.68	19	9%	21
16. Preventive maintenance programs:									
a. Regularly scheduled vehicle inspection and maintenance	91%	4.35	1	40%	3	4.07	8	13%	15
b. Trip sheets (driver documentation of pre- and post-trip maintenance inspections)	87%	3.76	23	11%	26	3.57	22	4%	28
17. Safety-related equipment on new vehicles:									
a. Basic equipment (e.g., engine specs, conspicuity lighting)	88%	3.97	12	14%	20	3.71	18	5%	24
b. Advanced technology collision avoidance systems (e.g., forward/rear obstacle detection)	16%	3.48	26	14%	20	3.68	19	13%	15
18. Within carrier management, alignment of operational and safety functions (e.g., the safety manager is also a direct supervisor)	59%	4.10	7	34%	6	3.89	14	23%	8
19. Safety management quality certification programs (i.e., involving outside consultant):									
a. Certification of carrier safety management practices	36%	3.85	18	15%	17	3.73	17	13%	15
b. Certification of individual fleet safety managers (i.e., professional certificate)	36%	3.96	14	15%	17	3.64	21	5%	24

in general and usually rated all 28 items, so the Ns for the various items were less variable. Consistent with this, the average number of ratings was much lower for safety managers than other experts. Safety manager respondents rated an average of 18 of the 28 items, whereas other expert respondents rated an average of 27 of the 28.

There was no consistent difference in the effectiveness ratings assigned by safety managers versus other experts. The overall means were very similar (3.89 versus 3.82). Moreover, because the safety managers rated only those practices that they used, direct comparisons of mean ratings between the two groups are not very meaningful. As previously mentioned, comparisons noted between safety managers and other experts will address their relative ratings of the various solutions, as opposed to their absolute mean ratings.

Once again, there were high correlations across the statistics for the 28 solution areas shown in Table 2.

Most solutions rated highly effective by the safety managers were also rated highly effective by the other experts, and vice versa. However, there were some differences. Examples from Table 2 include the following (note: lower rankings indicate higher relative effectiveness ratings):

- Requiring that new hires meet or exceed a minimum number of years of driving experience (Item 1a):
 - Safety managers: rated 4th of 28 solutions and
 - Other experts: rated 24th of 28 problems.
- Observation of driving behaviors through ride-alongs (Item 4a):
 - Safety managers: rated 8th of 28 solutions and
 - Other experts: rated 24th of 28 problems (tied with item noted previously).
- Regular refresher training for all drivers (Item 2c):
 - Safety managers: rated 16th of 28 solutions and
 - Other experts: rated 4th of 28 problems.
- Fatigue management programs (Item 14):
 - Safety managers: rated 18th of 28 solutions and
 - Other experts: rated 7th of 28 problems.

The various specific findings in Table 2 will be discussed primarily in the context of the individual safety management methods (see Chapter 4).

2.2.3 Respondent Information

Both survey forms asked respondents to provide some general demographic information about themselves and, for safety managers, their fleets. Key points are summarized as follows.

Safety Managers

The 139 safety manager respondents had been safety managers for an average of 12.0 years (range: 1 to 32) and had an average of 22.4 total years of experience in CVO (range: 3 to 43). Fleet size varied widely, ranging from 4 to 11,500 power units. The median fleet size was 200, indicating that the sample generally represented safety managers in larger fleets. Safety managers from LTL fleets generally represented very large operations; the median fleet size for these respondents was 1,475 power units. Figure 1 is a histogram showing the percentage of respondents in four fleet size categories for the overall sample (all operations types): small (1–24, 11%), medium (25–94, 24%), large (94–499, 34%), very large (500+, 32%). These specific ranges were selected for comparability with Corsi and Barnard (2003).

The survey asked safety managers to indicate the principal operation type of their fleet. The following is the breakdown:

- 49% for hire, long-haul/truckload;
- 13% for hire, long-haul/LTL;
- 10% for hire, local/short-haul (SH); most trips < 100 mi;
- 14% private industry [private carrier], long-haul (LH);
- 18% private industry [private carrier], local/short-haul (SH); most trips < 100 mi; and
- 3% other (1% passenger carrier, long-haul/motor coach; 2% mixed operations).

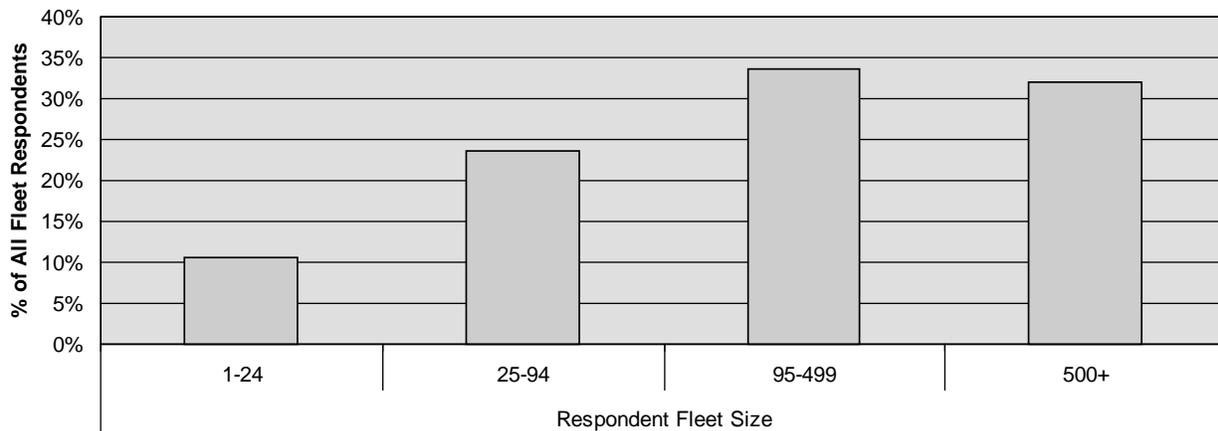


Figure 1. Safety manager respondent fleet size.

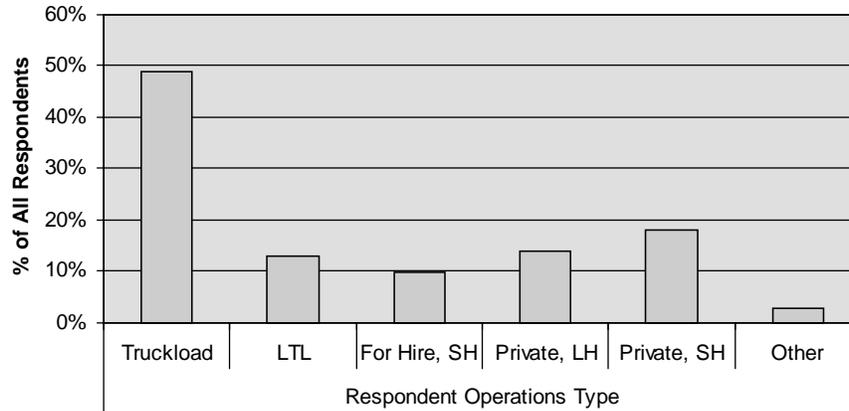


Figure 2. Respondent fleet operation type.

Figure 2 shows these results graphically. Since a few fleets had multiple respondents, the operation-type percentages are reflective of the respondents, but not the participating fleets per se. Also, a few respondents indicated more than one operations type, so the percentages add to slightly more than 100%.

The for-hire LTL fleets represented by respondents tended to be very large; the median was 1,475 power units. For-hire truckload fleets had a median of 210, and private long-haul fleets had a median of 100. Short-haul fleets (most of which were private) had a median of 76 power units.

Other Experts

The 57 other expert respondents had an average of 16.6 years experience relating to CVO traffic safety (range: 3 to 33). These respondents were asked to indicate their professional experience area(s) relating to CVO safety. The following is the breakdown:

- 23% government enforcement;
- 32% other government (e.g., rulemaking);
- 30% industry trade association;
- 18% CMV driver;
- 19% carrier safety manager;
- 37% accident investigation/data analysis;
- 12% other carrier management position;
- 54% CVO safety research;
- 2% journalist;
- 18% driver trainer;
- 10% insurance for motor carriers; and
- 9% other (e.g., safety consulting).

The above percentages sum to well over 100% because most respondents gave multiple responses. The results show that the experience base of the other experts was both extensive and varied, with heavy representation of individuals with backgrounds in government, accident investigation/data analysis, and research.

CHAPTER 3

SAFETY MANAGEMENT PROBLEM AREAS

What are the problems that CMV fleet safety managers should focus on in their efforts to achieve greater fleet safety? Driving, whether in a truck or car, involves basic knowledge, physical abilities and skills, and safe behavior practices. Ideally, safe behavior practices encompass defensive driving practices to anticipate and compensate for the mistakes of other drivers on the highway.

In many ways, driving a large truck or bus in commercial operations presents a far greater safety challenge than driving a “four-wheeler.” Mileage exposure and time behind the wheel are an order-of-magnitude higher for commercial drivers compared to non-commercial drivers. Thus, issues like fatigue, schedule delays, and general health are of critical importance for these drivers. And, since a loaded truck may be 20 times or more the size and weight of a car, severe vehicle damage and occupant injuries can result from CMV crashes, with non-CMV occupants the predominant victims.

Given these safety disadvantages compared to car driving, it is notable that commercial drivers generally have good safety records. The crash involvement rate per mile traveled of combination-unit truck (tractor-semitrailer) drivers is less than one-half that of cars and light trucks, and a much smaller percentage of their crash involvements are as the “at fault” vehicle (Craft 2000; Wang, Knipling, and Blincoe 1999). Commercial drivers are less likely than non-commercial drivers to seriously violate speed limits (NHTSA 1991) or engage in aggressive or risky driving behaviors. The majority of car-truck crashes are related more to the errors and misbehaviors of car drivers than to those of truck drivers (FHWA OMC 1999a). However, because of the high mileage exposure of trucks and the oftentimes severe consequences of their crashes, there is a premium on making trucks and truck drivers safer. Annual crash costs are more than four times greater for a combination-unit truck (tractor-trailer) than for a passenger car (Wang, Knipling, and Blincoe 1999).

This chapter addresses the “what” issue. Problem areas considered include deficiencies in driver skill, knowledge, or safety behavior; fatigue and other sources of impairment; physical and medical problems, attitudes, morale, and turnover; vehicle inspection and maintenance, and the problem of high-risk drivers associated with any of these problems. Findings from the scientific literature are cited, and results from the project surveys are presented and briefly discussed. The reader may also wish to refer to Table 1, which provides an overall summary of survey results for the 20 problem areas.

3.1 INSUFFICIENT TRAINING: LACK OF DRIVING SKILL AND KNOWLEDGE

A study published by the Office of Motor Carriers in 1995 (FHWA 1995) assessed the entry-level training of U.S. drivers of CMVs and concluded that neither heavy truck nor motor coach drivers generally receive adequate entry-level training. More recently, in an FMCSA R&T study called “Driver, Vehicle, and Roadside Strategies for 2010” (FMCSA 2002), “inadequate and infrequent training” of CMV drivers, with specific reference to on-the-job training in fleets, was cited as one of five high-priority safety problem areas. The level of driving proficiency and knowledge required to earn a commercial drivers license (CDL) is widely regarded in industry as well below the level required to be a safe and reliable driver in a full-time operational setting. Thus, the adequacy of driver skills and knowledge is an issue of concern for fleet safety managers.

The project survey problem area section included items on driver skills (No. 1a) and knowledge of regulations and rules (No. 1b). Survey results were as follows:

Problem Area 1a. Insufficient training: Lack of basic driving skills.

Respondent Type	Average Importance Rating		“Top Five” Selections	
	Avg. Rating	Rank (of 20)	% of Respondents	Rank (of 20)
Safety Managers	2.74	14	17%	12
Other Experts	3.26	17	16%	9

Problem Area 1b. Insufficient training: Poor knowledge of federal, state, and/or company rules.

Respondent Type	Average Importance Rating		“Top Five” Selections	
	Avg. Rating	Rank (of 20)	% of Respondents	Rank (of 20)
Safety Managers	3.04	12	18%	11
Other Experts	3.30	16	11%	13

Relative to other items in the problem set, driver lack of basic skills and knowledge were not highly rated as safety management problems.

3.2 AT-RISK DRIVING BEHAVIORS AND AGGRESSIVE DRIVING

At-risk driving behaviors include speeding, excessive speed on curves or in relation to weather conditions, improper following distance, lateral encroachment (e.g., during attempted lane changes; perhaps due to improper mirror use), failure to yield at intersections, and general disobedience of the rules-of-the-road. While all drivers exhibit one or more of these behaviors at times, the behaviors represent a major safety concern when they are frequent and constitute a pattern of behavior.

The most common truck driver behaviors cited and associated with fatal large truck crashes include failure to control vehicle (i.e., ran off road or out of lane), driving too fast, failure to yield right-of-way, inattentiveness, erratic/reckless driving, following improperly, and making improper turns (Craft 2000). Of course, these factors are generally more likely to be cited for passenger vehicle drivers than for large truck drivers in crashes.

In a study of local/short-haul commercial driving, Hanowski et al. (2000) identified the driver-related causes of “truck driver at fault” critical incidents (i.e., driver errors resulting in near-crashes or unsafe conditions) to include driver inattention, fatigue, stress due to time pressure, failure to follow proper procedures (e.g., use of mirrors while backing), overconfidence (e.g., excessive speed around corners), visibility, and distraction (e.g., cell phone use). Some of these may be characterized as inadvertent “mistakes,” while others represent intentional at-risk behaviors. Common specific driving errors include lane changes without sufficient gaps, roadway entrances without clearance, left turns without clearance, and late braking for stopped or stopping traffic (Hanowski, Keisler, and Wierwille 2001).

The FMCSA Driver, Vehicle, and Roadside Strategies project (FMCSA 2002) identified commercial driver moving violations, including speeding, erratic or reckless driving, and failure to obey traffic signs among its five high-priority safety issues.

“Aggressive” driving is difficult to define or distinguish meaningfully from “non-aggressive” at-risk driving. However, aggressive driving or “road rage” is generally considered to involve frustration- or anger-related driver emotions and actions characterized by extreme disregard for safety and menacing behavior toward other vehicles and drivers.

Project survey results relating to at-risk and aggressive driving were as follows:

Problem Area 2. At-risk driving behaviors (e.g., speeding, tailgating).

Respondent Type	Average Importance Rating		“Top Five” Selections	
	Avg. Rating	Rank (of 20)	% of Respondents	Rank (of 20)
Safety Managers	3.75	1	55%	1
Other Experts	4.21	3	58%	4

Problem Area 3. Aggressive driving (i.e., “road rage”).

Respondent Type	Average Importance Rating		“Top Five” Selections	
	Avg. Rating	Rank (of 20)	% of Respondents	Rank (of 20)
Safety Managers	3.26	7	26%	8
Other Experts	3.33	11	14%	11

As shown above, at-risk driving behaviors was among the very highest-rated and ranked safety problem for safety manager and was near the top for the other expert respondents as well. More than half of the respondents in both groups considered this to be a “Top 5” safety problem.

One safety manager respondent had a different perspective on at-risk driving behaviors; he suggested that “lack of operational discipline” was a more apt description. Per this view, a major goal of management is to establish driving rules and policies and ensure that drivers follow them.

The results for aggressive driving were somewhat mixed. Fleet safety managers rated the problem of somewhat greater importance than did other experts, but overall it was in the middle of the problem set. These results are difficult to interpret because it is possible that different respondents answered based on different definitions of aggressive driving. In addition, even though respondents were instructed to answer in regard to commercial drivers, some may have answered in regard to the overall traffic environment. The question warrants further study.

3.3 SPACE MANAGEMENT AND DEFENSIVE DRIVING

Studies relating to fatal crashes, all crashes, and critical incidents involving heavy trucks have consistently indicated that two-thirds or more of such events are precipitated by the actions of other motorists rather than those of the truck driver (FHWA 1999a; Hanowski et al. 2002; Hanowski, Keisler, and Wierwille 2001; Wang, Knipling, and Blincoe 1999). A study of the unsafe driving acts of other motorists around heavy trucks (FHWA 1999b) identified the following as being most common: changing lanes abruptly in front of a truck, driving left of center, following too closely, unsafe passing (primarily with insufficient headway), unsafe speed, merging improperly, and driving between large trucks. Given these statistics and the huge role that 4-wheeler driver behavior plays in truck crash causation, it is apparent that the space management and defensive driving skills of truck drivers play a critical role in their risk of crash involvement.

FMCSA maintains a web page (www.nozone.org) providing share-the-road, defensive driving, and space management information and tips for both commercial and non-commercial drivers.

The project survey included an item (No. 4) in the problem area section as follows:

Problem Area 4. Lack of defensive driving skills (e.g., space management around vehicle).

Respondent Type	Average Importance Rating		“Top Five” Selections	
	Avg. Rating	Rank (of 20)	% of Respondents	Rank (of 20)
Safety Managers	3.48	4	40%	4
Other Experts	3.58	8	23%	7

Fleet managers rated this among the top safety problems. For the other expert respondent group, it was rated and ranked somewhat lower, but still in the top one-half.

3.4 DRIVER FATIGUE

In the past decade, commercial driver fatigue has probably received greater press and government and industry attention than any other safety problem, in part because of the obvious but complex relation between fatigue and hours-of-service (HOS) regulations and enforcement. Commercial drivers drive long hours, often at night, and sometimes have irregular and unpredictable work schedules. Fatigue is an ever-present safety concern associated with the operational requirements of truck and bus transport.

Some studies, most notably those by the National Transportation Safety Board (NTSB), have indicated a very high involvement of fatigue in CMV crashes. Best known is NTSB’s 1990 study of 182 fatal-to-the-driver large truck crashes. The most frequently cited probable crash cause was driver fatigue, which was cited in 57 (31%) of the 182 crashes. Based on this study alone, fatigue must be considered a predominant risk factor for commercial drivers.

However, fatal-to-the-driver truck crashes represent a relatively small proportion of fatal truck crashes (about one-seventh) and a very small proportion of all truck crashes (about 1 in 700), and the risk of fatigue in these crashes is many times that of these larger crash populations. Knipling and Shelton (1999) presented range estimates of driver fatigue as a principal factor in heavy truck crashes, as a function of various parameters, including heavy truck type (combination or single-unit), crash severity, and depth of crash investigation (i.e., police accident report data vs. in-depth crash investigation data). These percentage estimates had a huge range—from 0.2% to 40%—a 200-fold range. Overall, based on in-depth crash investigations, fatigue was estimated to be a principal factor in about 1% of all large truck crashes and 3% to 6% of fatal large truck crashes (combining fatal-to-the-driver with fatal-to-other-motorists).

As emphasized by the project team, the most important deficiency in the above statistics is that they only address fatigue as seen and cited as a principal factor in crashes. They do not address the *contributing*, as opposed to primary, role that fatigue may play in crashes. Attentional lapses are reliably associated with sleep deprivation (Balkin et al. 2000; Dinges et al. 1998) and driver inattention is a very common contributing factor to crashes. Instrumented vehicle studies employing continuous driver alertness monitoring (using the PERCLOS eyelid droop metric) and driver error capturing are beginning to document and quantify the pervasive contributing role that fatigue can play in truck driving safety (Hanowski, Keisler, and Wierwille 2001).

Motor coach drivers face many of the same fatigue issues that truck drivers face. Focus group discussions with motor coach drivers have identified the presence of passengers in the vehicle as a major factor unique to motor coach driving that significantly contributes to motor coach operator fatigue. In particular, motor coach drivers cannot stop for a nap “on demand” as can a truck driver (FMCSA 2001a).

Various CMV safety forums have indicated fatigue as a priority safety problem. The 1995 Truck and Bus Safety Summit identified fatigue as the No. 1 safety problem. More recently, at a June 2001 driver and fleet safety conference, sponsored by the 21st Century Driver and Truck Alliance (Grace and Suski 2001), “consideration of driver fatigue as a major issue” was rated as a top priority for fleet safety managers. Also, in an FMCSA R&T study called “Driver, Vehicle, and Roadside Strategies for 2010” (FMCSA 2002), “fatigue, alertness, and distraction” was cited as one of five high-priority safety problem areas.

The project survey included an item (No. 5) in the problem area section as follows:

Problem Area 5. Driver fatigue/drowsiness.

Respondent Type	Average Importance Rating		“Top Five” Selections	
	Avg. Rating	Rank (of 20)	% of Respondents	Rank (of 20)
Safety Managers	3.37	6	29%	6
Other Experts	4.28	2	67%	2

The other expert respondent group rated CMV driver fatigue among the very top safety problems, and two-thirds considered it a “Top 5” safety problem. For the safety manager respondent group, it was rated and ranked somewhat lower—6th out of the 20 safety problems.

Different trucking operations types are associated with dramatically different daily and weekly schedules for drivers, and thus, potentially, different levels of fatigue. Below are the mean importance ratings placed on fatigue/drowsiness by safety managers from different operations types:

1. For hire, long-haul/truckload: 3.35;
2. For hire, long-haul/LTL: 2.56;
3. For hire, local/short-haul: 3.14;
4. Private industry [private carrier], long-haul: 3.58; and
5. Private industry [private carrier], local/short-haul: 3.32.

3.5 LOADING AND UNLOADING DELAYS AND RESULTING SAFETY PROBLEMS

Under the sponsorship of the FMCSA, the Trucking Research Institute (TRI) has conducted a major study on the effects of loading and unloading cargo on truck driver fatigue (O’Neil et al. 1999; Krueger and Van Hemel 2001). Phase I of the study included a literature review and focus group interviews with drivers (Krueger and Van Hemel 2001). Phase II was a simulation-based experimental study in which the alertness effects of performing loading tasks were compared to control drives not involving physical labor. These studies found no consistent evidence of fatigue resulting from the physical activity of loading and unloading. Instead, drivers overwhelmingly complained about the time required and unplanned delays associated with loading and unloading far more than about the physical work per se. Moreover, drivers in most segments of the truckload industry do not load and unload their trucks; that work is performed by shipper and receiver personnel. For these reasons, this discussion focuses on the delay issue rather than the effects of physical work.

“Hurry up and wait” at loading/unloading docks was cited by many drivers in the TRI focus groups as contributing to driver fatigue and unsafe driving practices. At many docks, trucks must queue up behind other trucks waiting to load or unload; drivers must remain awake and on duty during such waits. (Some shippers and receivers assign numbers to truckers as they arrive, thus permitting them to park the vehicle and rest during their waiting time.) The time lost at loading/unloading docks, if unplanned, puts drivers behind schedule, creating a real or perceived need to exceed speed limits and/or available work and driving hours under the HOS.

The project survey included an item (No. 6) in the problem area section as follows:

Problem Area 6. Delays associated with loading and unloading (e.g., resulting in long working hours, tight schedules, and fatigue).

Respondent Type	Average Importance Rating		“Top Five” Selections	
	Avg. Rating	Rank (of 20)	% of Respondents	Rank (of 20)
Safety Managers	3.45	5	40%	4
Other Experts	4.18	4	60%	3

Both respondent groups rated and ranked this as among the top carrier safety management problems. As one other expert respondent stated, “tight schedules lead to drivers getting in a big hurry, which leads to risky behavior.”

Operations-type differences were pronounced for this item also. Truckload safety managers assigned the item a mean rating of 4.04, and 51% of them ranked it as a “Top 5” item. For LTL safety managers, the corresponding statistics were 2.22 and 17%. For private long-haul carriers, the statistics were 2.74 and 32%.

3.6 ALCOHOL AND ILLICIT DRUG ABUSE

The 1990 NTSB fatal-to-the-driver crash investigation study identified alcohol and/or drug use as a close second to fatigue as a contributing factor in these fatal crashes. Fifty-three drivers (29%) tested positive for alcohol and/or drugs. More recently, FMCSA data relating to all fatal truck crashes (as opposed to fatal-to-the-truck-driver only) indicated that 1.3% of involved large truck drivers had blood alcohol content (BAC) levels of 0.10 or more, as compared with 19.7% of passenger vehicle drivers involved in fatal crashes (Craft 2000). Preliminary findings from the FMCSA/NHTSA Large Truck Crash Causation Study (LTCCS) indicate little alcohol and illegal drug use by truck drivers involved in crashes (Craft 2002).

Federal law requires all motor carriers employing drivers holding CDLs to have drug and alcohol testing programs. The random testing rates are 50% for controlled substances (drugs) and 10% for alcohol. In 1999, it was estimated that 1.3% of CDL holders tested positive for controlled substances and 0.2% for alcohol use (FMCSA 2001).

The project survey included an item (No. 7) in the problem area section as follows:

Problem Area 7. Alcohol and/or illicit drug abuse.

Respondent Type	Average Importance Rating		“Top Five” Selections	
	Avg. Rating	Rank (of 20)	% of Respondents	Rank (of 20)
Safety Managers	1.99	20	2%	20
Other Experts	2.54	20	2%	19

This safety problem received the lowest overall importance ratings and rankings from both respondent groups.

3.7 DRIVER HEALTH AND WELLNESS PROBLEMS

Driving is a continuous sensory-motor task that requires alertness and physical responsiveness to stimuli from the environment. Accordingly, certain core physical abilities and

basic medical health are essential for safe driving performance. FMCSRs (49 CFR 391.41) set physical qualifications standards for commercial drivers to prevent individuals with certain medical conditions from operating a CMV in interstate commerce. Disqualifying conditions include vision and hearing impairment, diabetes, and epilepsy. Current research is refining medical standards (e.g., on vision and diabetes) to make them more performance-based and thus more explicit, fair, and effective (FMCSA 2001c).

Lifestyle and General Health

In a report on CMV driver health and wellness, Roberts and York (2000) found that the prevalence of unhealthy lifestyles and associated medical conditions was significantly greater for CMV drivers than for the rest of the U.S. adult population. This includes significantly elevated rates (compared to the general adult population) of smoking, obesity, hypertension (high blood pressure), poor eating habits, physical inactivity, and stress. These behaviors and conditions contribute to absenteeism, increased medical costs, and reduced driver morale and retention. Few empirical studies have directly related these physical conditions to driving performance and crash involvement, but it is likely that they contribute substantially to reduced performance.

Survey results for this item are shown as follows.

Problem Area 8a. Lifestyle/general health-related (e.g., poor diet, smoking).

Respondent Type	Average Importance Rating		"Top Five" Selections	
	Avg. Rating	Rank (of 20)	% of Respondents	Rank (of 20)
Safety Managers	3.65	3	46%	2
Other Experts	3.79	6	44%	6

Notably, this was rated and ranked among the top safety management problems, with an even higher importance placed on the factor by safety managers than by other experts. Section 5.1 of this report addresses the issue in more detail.

Sleep Apnea

Sleep apnea is an emerging concern because of its profound disruption of sleep and its association with increased statistical risk of crash involvement (Stutts 2000). Obesity is a prime risk factor for sleep apnea, and the incidence of obesity among CMV drivers is approximately twice that of the general population (Roberts and York 2000). A major FMCSA-funded study, performed by the University of Pennsylvania under a subcontract with the TRI, estimated the prevalence of sleep apnea among CDL holders and also

quantitatively assessed how sleep apnea impairs driver performance (Pack et al. 2001 and 2002). The study found that mild sleep apnea occurs in 17.6% of those holding CDLs, moderate sleep apnea in 5.8%, and severe sleep apnea in 4.7%. These percentages are similar to those for the overall U.S. male population, but still indicate a significant medical and safety problem. The study also found progressive decrements in vigilance and other awake performance with increasing severity of sleep apnea. Sleep apnea sufferers tended to sleep less than other drivers, and the most marked deficits occurred in individuals with both severe sleep apnea and an average sleep duration of less than 5 hr/day. Partial sleep deprivation (i.e., less than 5 hr/night) was found to be more common (13.5%) than severe sleep apnea (4.7%), but these at-risk conditions overlapped in a disproportionate number of subjects. These estimates, as well as associated research findings on alertness and performance deficits, justify designating sleep apnea as a priority medical concern for commercial drivers.

Sleep apnea was a problem area addressed in the survey; the results are as follows:

Problem Area 8b. Sleep apnea.

Respondent Type	Average Importance Rating		"Top Five" Selections	
	Avg. Rating	Rank (of 20)	% of Respondents	Rank (of 20)
Safety Managers	3.07	11	9%	14
Other Experts	3.79	6	16%	9

Overall, sleep apnea was rated near the middle of the problem set, with somewhat greater importance placed on the issue by other expert respondents than by fleet safety managers.

Cardiovascular Illness

In the 1990 NTSB fatal-to-the-truck-driver study, nearly 10% of the crashes involved some form of cardiac incident. The following factors, all common among truck drivers, contribute to chronic and acute cardiovascular illness: elevated blood cholesterol, elevated blood pressure, excessive weight/obesity, lack of exercise, and smoking (Roberts and York 2000).

Evaluation of the item by survey respondents was as follows:

Problem Area 8c. Cardiovascular illness/heart disease.

Respondent Type	Average Importance Rating		"Top Five" Selections	
	Avg. Rating	Rank (of 20)	% of Respondents	Rank (of 20)
Safety Managers	3.19	8	13%	13
Other Experts	3.32	12	4%	17

Safety managers rated this as more important than other specific medical problems in the problem set. The ratings assigned by other experts were somewhat lower.

Prescription Drug Side Effects (e.g., Drowsiness)

No statistics were found relating to the incidence of prescription drugs among CMV drivers or their involvement as a contributing factor in crashes. However, prescription drug use is a factor being studied in the LTCCS, and preliminary results indicate that some cases are associated as a crash factor (Craft 2002). Survey results were as follows:

Problem Area 8d. Prescription drug side effects (e.g., drowsiness).

Respondent Type	Average Importance Rating		"Top Five" Selections	
	Avg. Rating	Rank (of 20)	% of Respondents	Rank (of 20)
Safety Managers	2.73	16	3%	19
Other Experts	3.32	12	2%	19

This problem was rated in the bottom one-half of the problem set by both safety managers and other experts. Its "Top 5" rankings were among the lowest of the 20 problems.

Mental Illness (e.g., Depression)

According to the National Institute of Mental Health, 22% of adult Americans suffer from a diagnosable mental disorder. Major disorders include depression, other mood disorders, and anxiety disorders such as panic disorders and obsessive-compulsive neurosis. The project survey included an item on mental illness as a health problem for commercial drivers. The results were as follows:

Problem Area 8e. Mental illness (e.g., depression, anxiety, mood disorders).

Respondent Type	Average Importance Rating		"Top Five" Selections	
	Avg. Rating	Rank (of 20)	% of Respondents	Rank (of 20)
Safety Managers	2.59	17	4%	17
Other Experts	3.05	19	4%	17

This problem was also rated and ranked near the bottom of the 20 safety problems.

3.8 DRIVER ATTITUDE AND MORALE

There are many factors that can undermine commercial driver attitude, morale, and overall level of personal happiness. Time away from home is a major factor, causing feel-

ings of loneliness and straining personal relationships. Other factors, such as long work hours, irregular schedules, dissatisfaction with pay or other job conditions, poor diet, and lack of regular exercise can contribute to unhappiness for some drivers. The project survey included an item in the problem area section as follows:

Problem Area 9. Poor attitude and morale, loneliness, alienation, unhappiness.

Respondent Type	Average Importance Rating		"Top Five" Selections	
	Avg. Rating	Rank (of 20)	% of Respondents	Rank (of 20)
Safety Managers	3.16	9	29%	6
Other Experts	3.47	9	14%	11

This problem was generally rated and ranked near the middle of the safety management problem set by both safety managers and other experts, although it was 6th in the "Top 5" rankings assigned by safety managers. One safety manager respondent stated his belief that "unprofessional" personal appearance and interpersonal demeanor were often associated with undisciplined driving, with resulting incidents and crashes. Another noted that some drivers have a general negative attitude toward management that can affect safety performance.

3.9 DRIVER TURNOVER

Driver turnover rates of 50 to 100% annually are common in many CMV operations. A recent FMCSA-sponsored report (Staplin et al. 2002) analyzed the relationship between driver job changes and safety and determined that frequent job changes or "churning" was associated with a significantly higher probability of crash involvement. For drivers who average three or more jobs with different carriers per year, the odds of being involved in an at-fault crash were found to be more than twice as high as for those with lower job change rates. The analysis was not able to discern the reasons underlying this relationship; whether, for example, it was job changes per se versus changes in geography, operations and cargo type, or other factors.

A factor related to both turnover and safety is driver attitudes. Taylor (1997) administered a questionnaire addressing drivers' attitudes toward their company and managers, including fairness, pay, dispatching, performance evaluation, and other factors relating to their job satisfaction and morale. He found that negative attitudes toward the company and job were associated with both intent to quit and unsafe driving records.

High driver turnover rates within a company mean that many of their drivers are new to their company and operation, and hence at greater risk for crash involvement. The cost of recruiting, selecting, hiring, and training a new driver

is often \$6,000 or more (Staplin et al. 2002). This cost and the management staff time required places a huge burden on fleet management, curtailing its ability to develop, implement, and sustain safety programs for the rest of their drivers.

The project survey included an item in the problem area section as follows:

Problem Area 10. Driver turnover resulting in unstable workforce.

Respondent Type	Average Importance Rating		“Top Five” Selections	
	Avg. Rating	Rank (of 20)	% of Respondents	Rank (of 20)
Safety Managers	2.96	13	23%	10
Other Experts	4.09	5	46%	5

The above survey results indicate that other experts place significantly greater importance on driver turnover as a safety issue than do fleet safety managers. Almost one-half of the other expert respondents considered this to be a “Top 5” problem. In their comments, some safety managers and other experts stated their belief that turnover and poor safety were related, and that both were related in part to driver pay.

The for-hire truckload segment of the industry generally has higher turnover than either LTL or private long-haul operations. Not surprisingly, safety managers from the truckload segment had significantly higher mean ratings for this item (3.43) than either LTL (2.17) or private long-haul (2.37). Thirty-seven percent (37%) of truckload respondents rated this as a “Top 5” item versus 17% of LTL managers and 11% of private long-haul managers.

3.10 DRIVER UNFAMILIARITY WITH ROUTES

The extent to which drivers encounter unfamiliar routes is largely a function of their type of operation (e.g., truckload operations are likely to involve occasional unfamiliar routes, whereas LTL operations generally schedule regular runs on the same roads). The project survey included an item in the problem area section as follows:

Problem Area 11. Drivers unfamiliar with routes.

Respondent Type	Average Importance Rating		“Top Five” Selections	
	Avg. Rating	Rank (of 20)	% of Respondents	Rank (of 20)
Safety Managers	2.74	14	9%	14
Other Experts	3.32	12	11%	13

Both respondent groups rated this item in the bottom one-half of the problem set. One safety manager commented that a good dispatcher can reduce the problem by assigning familiar routes to drivers or providing additional directions when needed.

By its nature, the for-hire truckload segment of the industry involves more unfamiliar routes for drivers, and this is reflected in safety manager assessments of this problem. The average importance rating assigned by truckload safety managers was 2.94 versus 1.94 for LTL and 2.58 for private long-haul.

3.11 VEHICLE MAINTENANCE, INSPECTION, AND LOAD SECUREMENT

Proper vehicle maintenance is widely considered an essential requirement for CMV safety, and federal and state governments have extensive regulations and enforcement programs to ensure that vehicles do not have mechanical defects or improperly functioning equipment. Roadside inspection out-of-service rates for mechanical problems are quite high—20% to 30% in recent years (Blower 2002). A key question is the degree to which these mechanical problems identified during inspections contribute to crash involvements. According to Fatality Analysis Reporting System (FARS) statistics, vehicle-related factors are coded in about 9% of the large trucks involved fatal crashes (Craft 2000), with brakes and tires being the most frequently cited defective components. Preliminary data from the LTCCS indicate a small percentage of truck maintenance factors in crash causation (Craft 2002). However, in-depth investigations performed by Michigan’s Fatal Accident Complaint Team have indicated that 55% of trucks involved in fatal crashes have at least one mechanical defect, and that about one-half of these would be sufficient to place the vehicle out of service in roadside inspections (Blower 2002). The extent to which this association connotes an actual causal or severity-increasing relationship is difficult to determine. Nevertheless, Blower (2002) concludes that brake, tire, and other mechanical defects contribute substantially to truck crashes.

The project survey included two items relating to vehicle maintenance and inspection within fleets.

Problem Area 12. Neglect of vehicle maintenance (e.g., brakes, tires).

Respondent Type	Average Importance Rating		“Top Five” Selections	
	Avg. Rating	Rank (of 20)	% of Respondents	Rank (of 20)
Safety Managers	2.36	19	8%	16
Other Experts	3.38	10	18%	8

Problem Area 13. Failure to inspect vehicle (e.g., pre-/post-trip).

Respondent Type	Average Importance Rating		“Top Five” Selections	
	Avg. Rating	Rank (of 20)	% of Respondents	Rank (of 20)
Safety Managers	3.16	9	24%	9
Other Experts	3.32	12	5%	15

Safety managers rated “failure to inspect vehicle” as a more important safety management problem than vehicle maintenance, whereas the opposite trend was seen in the data for other experts. Overall, these problems were rated in the middle or bottom one-half of the problem set by respondents. Most notably, safety managers considered this to be a relatively unimportant problem, perhaps because they considered their fleet maintenance programs to be effective. One other expert respondent stated the view that vehicle maintenance is most likely to be a safety problem for economically marginal fleets who cut corners to reduce costs and stay in operation.

Improper cargo securement is another vehicle factor that occasionally results in loss of cargo on highways and disastrous consequences to other roadway users. A North American Cargo Securement initiative (information is available at <http://www.ab.org/ccmta/ccmta.htm>) has developed a detailed load securement standard and is disseminating this information to North American fleets. A final vehicle-related problem area on the survey asked respondents to rate this problem from the safety management perspective.

Problem Area 14. Unsecured loads.

Respondent Type	Average Importance Rating		“Top Five” Selections	
	Avg. Rating	Rank (of 20)	% of Respondents	Rank (of 20)
Safety Managers	2.38	18	4%	17
Other Experts	3.23	18	5%	15

This problem was rated near the bottom of the problem set, perhaps reflecting the fact that unsecured loads are not a frequent occurrence, even though the consequences can be very

high when loads are not properly secured. In their written comments, however, a number of safety managers stated that load securement was a remedial and refresher training need for many drivers.

3.12 HIGH-RISK DRIVERS

The safety performance levels of CMV drivers vary widely, with a relatively small percentage of CMV drivers accounting for a disproportionate percentage of crashes or incidents. For example, in an FMCSA-sponsored instrumented vehicle study involving local/short-haul drivers and observation of truck-driver-caused incidents, about 5% of the drivers accounted for 26% of the incidents and about 20% accounted for 60% (Hanowski et al. 2000). One-third of the drivers had no incidents. In a study of long-haul drivers that employed similar monitoring (Dingus et al. 2001), 56 drivers were involved in 24 collisions or near-collisions. Of these, a single driver was responsible for seven of the events, while four drivers (7.1%) had a combined involvement in 13 events (54%). In the FHWA Driver Fatigue and Alertness Study, 14% of the 80 drivers in the study accounted for 54% of the drowsy episodes (Wylie et al. 1996).

The project survey included an item in the problem area section as follows:

Problem Area 15. High-risk drivers [all causes combined] (i.e., the degree to which managers should focus on the worst 10–20% of the drivers).

Respondent Type	Average Importance Rating		“Top Five” Selections	
	Avg. Rating	Rank (of 20)	% of Respondents	Rank (of 20)
Safety Managers	3.69	2	42%	3
Other Experts	4.43	1	68%	1

As shown, the problem of high-risk drivers was rated among the very top problems among both safety managers and other experts. Among other expert respondents, it received the highest average rating and “Top 5” ranking. The high-risk driver will be addressed in greater depth as one of four major safety issues in Chapter 5.

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 personal-

ity 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	%	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	%	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 policies 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 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.

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]).

Respondent Type	% Who Use	Effectiveness Rating		"Top Five" Selections	
		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.

Respondent Type	% Who Use	Effectiveness Rating		"Top Five" Selections	
		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.

Respondent Type	% Who Use	Effectiveness Rating		"Top Five" Selections	
		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.

Respondent Type	% Who Use	Effectiveness Rating		"Top Five" Selections	
		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

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.

Respondent Type	%	Effectiveness Rating		“Top Five” Selections	
		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:

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

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

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

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).

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

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 non-involvement 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

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

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]).

Respondent Type	%	Effectiveness Rating		“Top Five” Selections	
		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.

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

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:

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

Method 12. “How’s My Driving” placards and 800 numbers.

Respondent Type	%	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

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 exonerate a 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:

formed 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 perfor-

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 per-

formance 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.

Respondent Type	%	Effectiveness Rating		“Top Five” Selections	
		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 life-

style 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

centage 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:

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

major potential opportunity area for enhanced carrier safety management.

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 per-

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).

Respondent Type	% Who Use	Effectiveness Rating		“Top Five” Selections	
		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).

Respondent Type	% Who Use	Effectiveness Rating		“Top Five” Selections	
		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:

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

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

Respondent Type	% Who Use	Effectiveness Rating		“Top Five” Selections	
		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.

Respondent Type	% Who Use	Effectiveness Rating		“Top Five” Selections	
		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).

Respondent Type	% Who Use	Effectiveness Rating		“Top Five” Selections	
		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

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.

CHAPTER 5

DISCUSSION OF SELECTED SAFETY OPPORTUNITY AREAS

This chapter describes four study topics selected by the authors as areas of great safety opportunity for truck and bus transportation. For all four topics, the research literature and other information about the industry indicate that significant safety gains are possible by focusing on the issue or employing the safety management methodology. The four issues are (1) driver health, wellness, and lifestyle; (2) high-risk drivers; (3) behavioral safety management; and (4) safety management professionalism.

The first two of these issues are problem areas receiving high importance ratings in the survey and for which there is also strong research evidence and industry consensus highlighting their importance. The second two are general approaches to improved safety management, both of which involve various specific techniques. In the survey, these two solution areas generally did *not* receive relatively high ratings of safety management effectiveness by respondents. Yet, there is scientific literature and other rationales for believing that these approaches could have a significant positive impact on the CMV industry if employed.

These four topics provide many R&D needs and opportunities, that is, areas where new knowledge or new tools could have significant impact. These R&D needs are enumerated at the end of each topic discussion.

5.1 DRIVER HEALTH, WELLNESS, AND LIFESTYLE

5.1.1 The Driver Health Problem

Few studies have assessed the true national burden of poor health. Identification of the prevalence rates of various physical and medical conditions for different occupations is a first step in designing prevention techniques. Unfortunately, even when there is increased attention to and knowledge of health risk factors, obesity, physical inactivity, poor diet, and other “behavioral health” problems have all been on the rise since 1990 (Nelson et al. 2002). The economic importance of these trends is highlighted by the fact that 125 million people in the United States work for a living (Leigh and Miller 1998).

Truck and bus drivers appear to be at risk for a variety of physical as well as mental disorders. Congressional reports have indicated that “job stress, work posture, dietary habits, vibration, noise, carbon monoxide exposure, and postural

fatigue” among CMV drivers are factors associated with an increased risk of detrimental health effects (U.S. DOT 1988). A nationwide analysis of occupational illnesses by the Bureau of Labor Statistics found that commercial drivers were more likely than most other occupations to have various disorders, ranging from myocardial infarctions to neurotic reactions to stress (Leigh and Miller 1998). The project team’s survey findings suggest that both safety managers and other experts are aware health and wellness issues are a significant problem in CMV operation. Of the 20 safety problems presented to respondents, “driver health and wellness—lifestyle and general health” was rated No. 3 in importance by fleet safety managers and No. 6 by other experts. However, these two groups rated fleet-based medical and health and wellness programs relatively low in effectiveness. This implies a need for more systematic approaches in identifying health and wellness risk factors and assessing primary prevention techniques for CMV drivers.

Each year, an estimated 300,000 U.S. adults die from obesity-related causes. Obesity has been associated with an increased risk of diabetes, hypertension, myocardial infarction, and strokes. In 2000, the prevalence of obesity in the United States was 20%. In a survey conducted by Korelitz et al. (1993), the prevalence of obesity in commercial drivers was 33%. Further, 73% (compared to 66% in the U.S. population) of commercial drivers were considered overweight.

Contributing to the increased risk of obesity in commercial drivers are their poor eating habits and inactivity levels. Their working conditions include irregular work and rest cycles, long working hours, and irregular mealtimes, all of which contribute to potential poor nutrition and activity habits. More than 50% (compared to 27% in the U.S. population) of commercial drivers indicated they never participated in any physical activity, while less than 10% reported exercising regularly (Korelitz et al. 1993). Eighty percent of commercial drivers reported eating only one to two meals per day, with the preferred meal being a steak or hamburger (Holmes, Power, and Walker 1996).

Hypertension is one result of obesity, poor eating habits, and lack of physical activity. Commercial drivers were comparable to the national norm for high blood pressure, but they are often unaware of it. Sixty-six percent of commercial drivers with high blood pressure had not been informed by a doctor, compared with 46% of the general U.S. population.

The exact performance effects and safety toll resulting from poor driver health are not known, but it stands to reason that the overall driving performance levels of commercial drivers are significantly reduced by various health problems. For example, obesity is a major risk factor for cardiovascular illness, diabetes, and sleep apnea—all conditions associated with elevated crash risk. The high importance rating given to the health and wellness problem in the surveys is further evidence that a consensus is developing about the need to address this industry problem effectively.

5.1.2 Motor Carrier Wellness Programs

As discussed briefly in Chapter 4, the FMCSA, American Transportation Research Institute (ATRI, formerly the ATA Foundation), the NPTC, and Sue Roberts Health Concepts have partnered to assess commercial driver wellness needs and to design, develop, and evaluate a driver wellness program (Roberts and York 2000). This program represents a small, but tangible and seminal effort to introduce wellness as a health and safety initiative in CMV transport.

In their survey and design study, Roberts and York (2000) found few CMV fleets with comprehensive health and wellness programs for their drivers. Such comprehensive programs may include health screenings, identification of the prevalent health problems of the company's drivers and associated lifestyle issues (e.g., diet, exercise), design and delivery of wellness education and counseling, fitness programs and subsidies for fitness club memberships, and continuing promotional activities such as lunch seminars and fitness-related stories in company newsletters.

Health assessment protocols might include the following activities, supervised and conducted by qualified health professionals: (a) testing health knowledge, (b) testing self-knowledge (e.g., do drivers know their blood pressure levels?), (c) written lifestyle assessment, (d) blood testing (e.g., cholesterol, glucose), (e) blood pressure and pulse measurement, (f) weight and body mass index determination, (g) aerobic fitness testing, flexibility testing, and (h) strength testing.

Roberts and York (2000) contacted 23 trucking companies and found 6 who had health and wellness programs they were willing to describe in the phone interviews. All six were from large fleets, ranging from 500 to more than 10,000 drivers. By-and-large, these programs were rudimentary and did not appear to be effective. For example, participation rates among drivers were generally very low.

In the current survey, medical screening and counseling and general health and wellness counseling were employed by less than one-half of the responding safety managers, even though the survey sample was largely reflective of the most safety-conscious managers of larger fleets—the fleets most likely to have such programs.

In recent years, the ATAF, working with the NPTC and with funding from FMCSA, has developed a “Gettin’ in

Gear” multimedia driver wellness program. This program, described in an FMCSA “tech brief” (FMCSA 2000), 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.

In a pilot administration of the program, a group of drivers were presented the program along with follow-up individual coaching. Although the results of the pilot test were somewhat mixed, the drivers did show improvements in health lifestyle and, in particular, exercise and fitness. Marketing of “Gettin’ in Gear” will target several audiences: (a) drivers, (b) fleet owners, (c) safety managers, or (d) other decision makers who might recognize the importance and potential effectiveness of these programs.

“Gettin’ in Gear” developers have recommended a promotional plan to widely publicize the program and train-the-trainer sessions that are offered by ATRI to introduce the program to carriers and prepare safety managers to provide the training to drivers. Successful dissemination of “Gettin’ in Gear” will hopefully encourage fleets to provide more comprehensive health and wellness services to their drivers and encourage drivers to begin a “wellness journey” (FMCSA 2000; Roberts and York 2000).

Roberts and York (2000) enumerate the many organizational elements necessary for successful programs including the following:

- Strong and clear commitment from senior management;
- Financial and personnel support;
- Strong program leadership;
- Staffing with effective and qualified professionals;
- Thorough and accurate needs assessment;
- Understanding the stages and processes of behavior change;
- Effective marketing and communication;
- Accessibility for drivers;
- Attractive physical environment (e.g., fitness facility);
- Individualized to meet needs of different drivers; and
- Sound evaluation and continuous program improvements.

The FMCSA has announced an education and outreach program focusing specifically on the problem of obstructive sleep apnea among CMV drivers. A recent FMCSA-sponsored study (Pack et al. 2002) described in Chapter 3 found that nearly 30% of CDL holders suffer from some degree of sleep apnea, and that severe sleep apnea is associated with significant deficits in driving-relevant task performance. Solicitation DTMC75—02-R-00133, announced by the agency in September 2002, will fund the design, development, evaluation, and implementation of a multi-tiered Internet-based

education/outreach program for use by drivers, motor carriers, and shippers/consignees that addresses the problem of sleep apnea and best practices for dealing with it in operational CMV settings.

5.1.3 R&D Needs

Compelling R&D needs relating to the commercial driver health and wellness problem and deployment of fleet-based wellness programs and practices include the following:

- Quantitative determination of the role that various physical and medical conditions play in driver productivity and safety, including assessment of economic impacts so that cost-effectiveness of interventions targeting various conditions can be assessed.
- Evaluation of the “Gettin’ in Gear” wellness program (and similar programs such as the planned sleep apnea education/outreach program) in various fleet settings to demonstrate the value of the program and determine the conditions under which it is most successful. This should include close follow-up with individual driver participants to see the degree to which the program changes attitudes and behaviors.
- Development of more comprehensive wellness programs comparable to those employed in other U.S. industries. Extensive information and resources relating to these programs exists; they simply need to be adapted for the CMV operational setting and the unique requirements of trucking operations. Such programs, if well-designed, packaged, and marketed, would likely be adopted by enough fleets to constitute a reliable test bed for evaluation and springboard for cultural changes needed to make health and wellness the norm, rather than the exception, among CMV drivers.

5.2 HIGH-RISK DRIVERS

5.2.1 Problem Importance

One of the very highest rated problem areas in the survey was Item 15, as follows: “High-risk drivers [all causes combined]; i.e., the extent to which managers should focus on the worst 10-20% of drivers.” For safety managers, this problem area was rated second in importance of the 20 problem areas, and for other experts it was rated the highest overall.

This is not a specific problem or shortcoming of drivers, like fatigue or poor defensive driving, but rather a subpopulation of drivers representing a particular concern for safety managers and others involved in motor carrier safety. Many studies of driver safety and performance have noted the skewed distribution of crashes and other safety behavior indices among groups of drivers. Reliably, a relatively small percentage of drivers accounts for a much larger percentage

of crashes. To an extent, this is to be expected based on simple probabilities; even if crashes were completely random events, some individuals would be unlucky and be involved in multiple crashes, while many others would be lucky and have no crashes. The Poisson probability function describes the distribution resulting from *random* discrete events, where one occurrence has no effect on subsequent ones, so that some specific outcomes can occur more than once while many others do not occur at all.

Random occurrence may contribute to a disproportionate distribution of crashes and other incidents among drivers, but available research and industry opinion support the view that the effect is primarily due to variations in driver safety behavior. As described briefly in Chapter 3, an FMCSA-sponsored instrumented vehicle study found that, of 42 local/short-haul drivers and 77 truck-driver-caused incidents, two drivers (4.8%) accounted for 26% of the incidents; and eight drivers (19%) accounted for 60% of the incidents (Hanowski et al. 2000). Fourteen (33%) of the drivers were involved in no incidents. In a study of long-haul drivers that employed similar instrumentation and monitoring (Dingus et al. 2001), 56 drivers were involved in 24 collisions or near-collisions. Of these, a single driver was responsible for seven of the events, while four drivers (7.1%) had a combined involvement in 13 events (54%). In the FHWA Driver Fatigue and Alertness Study, Wylie et al. (1996) found that, of 80 drivers in the study, 11 (14%) accounted for 54% of the drowsy episodes. In an experimental study of the effect of sleep deprivation on alertness, Dinges et al. (1998) found wide variations in the level of performance decrement among 14 subjects. A subset of these subjects accounted for a disproportionate number of performance lapses. Four of the subjects were retesting using the same sleep deprivation protocol several months later and exhibited almost identical relative patterns of performance deterioration, suggesting large, enduring individual differences in the ability to sustain alertness during sleep deprivation.

Industry safety experts are aware of this variation in driver safety and the paramount need to incorporate this awareness into fleet safety management. For example, the following 4 relevant recommendations were among the top 10 safety recommendations resulting from the 2002 International Truck and Bus Safety Research and Policy Symposium at Knoxville (Zacharia and Richards 2002):

- Standardized entry-level driver training and remedial training for problem drivers.
- Information systems to provide driver risk data to fleets (e.g., employment history, physical qualifications, training, crash and traffic violation history, and prior drug/alcohol records).
- Behavioral research and analysis to identify high-risk drivers exceeding reasonable driving parameters such as hard braking, moving violations, HOS violations, and complaints from the public.

- Improved “people management” information and skills relating to selection and retention of safe drivers.

5.2.2 Past Behaviors Predictive of Driver Crash Rates

Individual characteristics known to affect future crash and incident involvement include: (a) prior history of crashes and traffic convictions, (b) being young, (c) being male, (d) being inexperienced, (e) increased exposure, that is, miles traveled, (f) poor social adjustment, (g) being poorly educated, (h) some personality traits, and (i) previous criminal record (Peck 1993).

Prior traffic violations are one way to predict future crashes and incidents. Rajalin (1994) randomly selected 615 non-commercial drivers involved in fatal crashes and 143 drivers stopped by police for risky driving from prior driving records. He found that drivers involved in fatal crashes and risky driving had significantly more traffic offences prior to these incidents than other drivers. These high-risk drivers were more likely to receive speeding tickets and be involved in running-off-the-road crashes than other drivers. Chen, Cooper, and Pinili (1995) examined nearly two million drivers' records and discovered a consistent increase in crashes and convictions for those drivers who had prior traffic convictions and at-fault crashes. The authors suggested that identifying high-risk drivers by their at-fault crashes as opposed to prior traffic convictions would result in identifying 23% more high-risk drivers.

Young males are more likely to be involved in crashes and incidents than other groups (Peck 1993; Rajalin 1994; Abdel-Aty and As-Saidi 1999). Driving experience can also affect future crash involvement. Cooper, Pinili, and Chen (1994) examined driving exposure and crash involvement (culpable and nonculpable) in 149,000 inexperienced non-commercial drivers between the ages of 16 and 55. Inexperienced drivers, when compared to experienced drivers of the same age, were involved in more culpable vehicle crashes: however, there was no difference between groups when assessing nonculpable crashes.

5.2.3 Psychometric Approaches to Predicting Commercial Driver Crash Risk

While driving history and some demographic characteristics may help predict crash risk, the deeper question is whether there are personal cognitive or behavioral traits that can be used to identify and better understand high-risk drivers. For example, West, Elander, and French (1993) surveyed 711 non-commercial drivers and found that individuals with the Type-A behavior pattern (sense of time urgency, competitiveness, alertness, and ambitiousness) and low thoroughness in decision-making style (tendency not to plan ahead or approach decision making in a logical manner) were

more likely to be involved in a vehicle crash. These individuals have also been shown to hold a risk/sensation-seeking attitude, characterized by their involvement in high-risk activities, such as drinking and driving. Aggressive, sensation seeking, and low emotional stability drivers were judged to have lower levels of driving skill when driving on a simulated driving course (Deery and Fildes 1999). Dewar and Olson (2002) provide a lengthy discussion of individual differences relevant to driving safety, including its relationship to personality traits such as neuroticism, extraversion, aggressiveness, “fatigue proneness,” and on the positive side, conscientiousness.

The FMCSA R&T program, through the U.S. DOT Small Business Innovation Research (SBIR) program, has a project underway to develop a low-cost driver assessment tool for use during applicant screening (FMCSA 2001c). The PC-based driving simulation will attempt to measure safety-related cognitive skills, vigilance, performance capabilities, and behavioral tendencies. The device will present drivers with simulated traffic situations requiring safe vehicle control, recognition of crash threats, defensive driving behaviors, decision making, and execution of appropriate evasive maneuvers. The device is envisioned primarily as a selection tool, although it could also be used to assess and counsel current drivers (FMCSA 2001c).

The *Truck Driver Risk Assessment Guide* (ATAF 1999b) describes several psychological tests (mostly personality and occupational interest profiles) that are commercially available to fleets.

A 4-min paper-and-pencil or computer-administered sensory-motor test that requires subjects to connect numbered and alphabetized boxes presented in random patterns or increasing complexity has been developed as a driver crash risk assessment instrument. The developer of the test claims that it “identifies the 20% of drivers who have about 60% of the collisions.” The developer cites a study of the Metropolitan Atlanta Rapid Transit Authority (MARTA) transit drivers in which 39 of 51 drivers were correctly classified as low or high risk based on test results. More specifically, the test identified 17 of 23 high-risk drivers (based on preventable collisions for a period of 2 years before the test) and 22 of 28 low-risk drivers. The developer claims that a 25% reduction in fleet collisions is a “realistic expectation” if the test is used as a selection tool.

While the above findings are tantalizing, they do not constitute a large, reliable, and public domain database of commercial driver personality and behavioral factors, metrics for assessing them, or quantitative relations to crash risk. Sharper and more extensively verified tools are needed to identify and quantify specific driver physical, performance, or personality characteristics associated with crash involvement. Boyle, Meltzer, Hitz, and Knipling (2002) suggest using a case-control design to estimate the relative crash risks associated with individual driver characteristics. In a collaborative planning study involving the Volpe National Transportation

Center and the FMCSA, a methodology and project plan were developed to compare crash-involved to non-crash-involved commercial drivers to determine the relative risk associated with selected driver characteristics (e.g., age, years of experience, training, violations, crash history, sensory-motor performance), physical/medical qualifications (e.g., vision, hearing, diabetes, epilepsy, sleep apnea), vehicles (e.g., configuration, load), schedule factors (e.g., work schedule, time-of-day), and environmental factors (e.g., weather, roadway). The study would derive odds-ratios and other statistical metrics of the quantitative risk associated with every factor measured including, potentially, dozens of driver physical, medical, performance, and personality dimensions, as well as various vehicle and environmental factors.

5.2.4 Intervention

The existence of high-risk drivers presents both a problem and an opportunity to safety managers; the opportunity is to find ways to eliminate the high risk and resulting outcomes associated with a few drivers, either by avoiding the hiring of these drivers, terminating their employment if hired, or successfully changing their driving behavior patterns. Survey respondents from the I-95 Corridor Coalition Field Operation (Stock 2001) indicated a variety of hiring criteria aimed at identifying high-risk drivers including the following:

- Between 77% and 93% of respondents turn down applicants if their driving records are below company mandated standards.
- Nearly every manager responded contacted prior employers to validate the driver's employment history.
- Many respondents required new applicants to complete psychological profile tests to assess for risk-taking, psychological well-being, and personality characteristics.

The current survey included a number of specific safety management approaches applicable to high-risk drivers. The following were among the most frequent and highest-rated of the 28 safety solutions by safety-conscious safety managers:

- Hiring based on criteria relating to driver crash, violation, or incident history (90% use; 2nd highest effectiveness rating).
- Requiring that new hires meet or exceed a minimum number of years of experience (86% use, 4th highest rating).
- Continuous tracking of driver's crashes/incidents/violations (92% use, 3rd highest rating)
- Remedial training programs for problem drivers (69% use, 10th highest rating).

Risk ultimately translates into behaviors, either unsafe driving behaviors that create increased risk or the lack of defensive driving behaviors to avoid risk. Behavioral safety man-

agement approaches, to be described in-depth in Section 5.3, are intended to directly target and reduce such behaviors.

5.2.5 R&D Needs

Future work on the high-risk commercial driver is planned within the TRB CTBSSP. A CTBSSP research project, *Individual Differences and the "High-Risk" Commercial Truck and Bus Driver: Implications for Carrier Human Resource Management*, will be initiated in mid-2003. Per the scope, this research project will (1) summarize available information on the individual differences in commercial driver safety performance and alertness, and examine the reliability and validity of various metrics and tests that might be employed to hire better drivers; (2) identify safety management techniques used by commercial vehicle carriers to target problem drivers and their specific risky behaviors; (3) conduct a scan of other industries that employ safety-sensitive individuals (e.g., airlines, nuclear power facilities, railroads, maritime facilities, and the military) and summarize key techniques used to identify and address high-risk individuals/employees; and (4) identify and discuss institutional and regulatory issues that affect the ability of an employer to address potential or current high-risk employees. The study will examine the degree to which individual differences in commercial driver safety reflect long-term, enduring personality traits (pointing to the need for better classification and screening), versus learned behaviors that may be readily changed by appropriate BBS management (e.g., training, performance feedback, rewards and punishments). The study will also identify needs for (a) research to delineate CMV driver individual differences and (b) tools to aid fleet safety managers in better managing their human resources from the safety perspective.

Some major empirical research needs relating to high-risk drivers are already apparent, however. They include the following:

- Systematic and extensive studies to identify all major human dimensions potentially associated with driver crash risk, selection of the best available instruments to measure them, and empirical determination of their effect on crash risk, perhaps employing both prospective and retrospective records of crash involvement. Instrumented vehicles might also be employed to provide direct, naturalistic observations of driver safety-related behaviors, thus providing a more reliable criterion measure of safety. As discussed previously, the case-control crash risk study design, already prepared for implementation by the FMCSA (Boyle, Meltzer, Hitz, and Knipling 2002), would address this research need in relation to many diverse driver dimensions and other contributing factors. In this context, it is notable that the FMCSA/NHTSA Large Truck Crash Causation Study will determine the prevalence of various factors

and events associated with crashes, but will not directly quantify the increased risk associated with preexisting factors, because the study does not have a control group (Craft 2002). Thus, implementing a case-control study, as planned by FMCSA, would fill an important gap in the understanding of CMV crash genesis.

- Once drivers are hired, how can fleet safety managers assess their relative crash risks, and take proactive steps to reduce their high risks? Once drivers are hired, the problem shifts from improving selection to improving performance assessment and management intervention. Comprehensive fleet-based studies could identify the operational performance assessment metrics most associated with driver crash involvement and the management techniques that have the greatest impact on these metrics and crash outcomes.
- After these studies have identified the underlying factors of risk and productive means to affect them, the knowledge and tools need to be packaged and disseminated to the industry. The FMCSA “Safety is Good Business” program, for example, may be an excellent vehicle to disseminate new knowledge and tools as they are acquired. Industry trade association safety councils are another vehicle to convey new knowledge and methods to those fleet safety managers most likely to implement them.
- One specific application of this new knowledge would be the development and validation of vastly improved, multifactor selection protocols for CMV drivers. Such protocols could include personal history assessments, physical/medical examinations, personality tests, and performance tests.

5.3 BEHAVIORAL SAFETY MANAGEMENT

The Indiana Tri-Level Study (Treat et al. 1979) and other studies of crash causation (Najm et al. 1995; Craft 2002) have indicated that the vast majority of traffic crashes are principally related to human causes, either misbehaviors, inadvertent errors, or impaired states. The current survey findings support this view. Both safety managers and other experts rated at-risk driving behaviors (e.g., speeding, tailgating, improper following distance, etc.) as a “Top 5” safety management problem affecting CMV fleet safety.

Identifying the factors related to these at-risk behaviors is of paramount interest. Behavioral safety management interventions are designed to increase specific safe driving behaviors and decrease specific at-risk driving behaviors. BBS is the primary approach to behavioral safety management. Other variations, or extensions, relevant to CMV safety include BBS self-management, driver incentive programs, safety placards, and OBSM. These are discussed subsequently as significant opportunity areas for improved safety management.

5.3.1 Behavior-Based Safety

For the past 20 years, BBS has been used successfully in the prevention of occupational injuries in numerous industrial settings. These interventions have not only reduced at-risk behaviors and increased safe behaviors, but have led to significant reductions in injury rates and compensation claims (Guastello 1993; Hantula, Rajala, Kellerman, and Bragger 2001). BBS can be administered by individuals with minimal professional training, can reach people in the setting where the problem occurs (e.g., community, school, workplace), and are cost-effective. People can be taught the behavior-change techniques most likely to work under specific circumstances (Baer, Wolf, and Risley 1987; Daniels 1989; Geller 2001; Sulzer-Azaroff and de Santamaria 1980; Krause 1999).

BBS involves interventions directed toward safety-related target behaviors, first by identifying and defining target behaviors, and second by observing and recording behavior in its natural setting. When a baseline measure of the frequency of behavior is obtained, an intervention is implemented to change the behavior in beneficial directions. Interventions involve modifying or changing antecedents (events prior to behavior that direct behavior) and consequences (events after behavior that motivate behavior) of specified target behavior(s). Behaviors followed by positive consequences are more likely to be repeated in the future; those followed by negative consequences are less likely to be repeated. To determine intervention effectiveness, the frequencies of target behaviors are recorded during these interventions and compared to baseline measures of behavior (see Daniels 1989; Geller 2001).

One of the primary tools used to influence behavior in BBS is peer observation and feedback. Coworkers systematically observe fellow coworkers and record the occurrence of safe and at-risk safety behaviors on a checklist. Results can be based on individual or group performance (see Zohar, Cohen, and Azar 1980). Yet, this approach may be difficult to implement with professional drivers, who are typically solitary workers. Having another individual conduct behavioral observations can be costly and time-consuming, and the driver may react to being observed. Thus, the observer might not see an accurate depiction of the driver’s habits. Thus, a self-management approach within a BBS framework may be most appropriate for solitary workers or workers with little oversight, such as CMV drivers. This is described in more detail in Section 5.3.2.

One possible substitute for direct observation of CMV drivers is telephone conversations between dispatchers (or safety managers) and drivers on the road regarding specific safety practices. In this approach, the dispatcher asks the driver a standard series of questions over the telephone about whether prescribed safety practices are being performed. This helps to remind drivers of fleet safety expectations and their accountability for their actions.

Because it is “employee-driven,” BBS is one of the best ways to actively, and substantively, involve workers in improving safety. A number of survey respondents mentioned the value of involving drivers in fleet safety initiatives, and one of the top seven safety action items adopted at the June 2001 fleet safety conference sponsored by the 21st Century Driver and Truck Alliance was to “develop programs for management to encourage driver participation in developing safety programs” (Grace and Suski 2001).

Often, in BBS applications, increases in targeted safety-related driving behaviors lead to increases in non-targeted safety-related driving behaviors. This is termed generalization (Ludwig and Geller 1991; Ludwig and Geller 1997). This process of generalization allows safety professionals to target a few specific driving behaviors with benefits across many more non-targeted behaviors, and is thus a less cumbersome application.

Given the impressive industrial safety track record of BBS, it’s notable that this survey of safety managers rated BBS approaches relatively low in effectiveness (22nd of 28 solutions) as a solution for CMV fleet safety. The other expert respondents related it higher, but not among the very top approaches, that is, 12th of 28 solutions. Both of these groups selected at-risk driving behaviors as among the most important problem areas influencing CMV fleet safety. Why the discrepancy? Several hypotheses can be surmised from the literature review. First, the traditional BBS peer-observation and feedback techniques are largely impractical in CMV transport. As mentioned, a self-management approach within a BBS framework may be more appropriate. Second, behavioral approaches may be implemented incorrectly or unsystematically in some fleets. BBS is most effective if implemented as a systems approach. The project team believes that, given the proven effectiveness of BBS in other industrial settings, its systematic application in CMV fleets would yield impressive results and become established as a primary fleet safety management approach.

5.3.2 BBS Self-Management

Self-management is a behavior-based improvement process whereby individuals change their own behavior in a goal-directed fashion (Mahoney 1971 and 1972) by (a) manipulating behavioral antecedents; (b) observing and recording specific target behaviors; and (c) self-administering rewards for personal achievements (Geller and Clarke 1999; Kazdin 1993; Watson and Tharp 1997). Research indicates that five self-management procedures can facilitate behavioral improvement including (a) activator management (Heins, Lloyd, and Hallahan 1986), (b) social support (Stuart 1967), (c) goal setting (Locke and Latham 1990), (d) self-monitoring and self-recording (Lan, Bradley, and Parr 1993), and (e) self-rewards (Sohn and Lanal 1982).

Unfortunately, the potential benefits of using self-management techniques to improve safety-related behaviors

have not been widely studied or evaluated. Three published studies include reports of the use of self-management techniques to increase the safety practices of bus drivers (Olson and Austin 2001), CMV drivers (Krause 1997), and short-haul truck drivers (Hickman and Geller 2002). Olson and Austin (2001) used a combination of self-monitoring and feedback with commercial bus drivers to influence a 12.3% increase in a variety of driving behaviors (including, complete stop, bus in motion, and loading and unloading passengers), with individual increases in performance ranging from 2% to 41%. Krause (1997) used a combination of self-monitoring and feedback with commercial motor vehicle drivers and reported a 66% reduction in injuries and crashes. Hickman and Geller (2002) used a combination of goal setting, self-monitoring, and objective feedback to influence a reduction in one group of drivers’ mean percentage of time speeding by 30.4%, and their mean frequency of extreme braking incidents by 63.9%. For another group of drivers, the mean reductions were 27% for speeding, and 49% for extreme braking.

Implementing self-management programs. Self-management can be implemented as a six-step process:

1. Establish a behavioral baseline using self-monitoring, identifying antecedents and consequences associated with the occurrence and non-occurrence of the target behaviors (Cormier and Cormier 1991).
2. Identify target behaviors (Cervone and Wood 1995).
3. Select a self-management strategy to promote desired behavior change and chart progress.
4. Select a goal that is specific, motivational, attainable, relevant, and trackable (Geller 2001 and 2002).
5. Self-observe and self-record target behavior(s) to measure progress toward the goal (Kirschenbaum, Ordman, Tomarken, and Holtzbauer 1982).
6. Administer self-rewards that are accessible, individualized, valued, varied, and follow the targeted behavior as immediately as possible (Cormier and Cormier 1991).

Self-management involves three critical elements, as depicted by the Self-Management for Safety (SMS) Model in Figure 4. The SMS model suggests the combination of self-monitoring, objective feedback, and goal-setting provides the most cost-effective self-management process. With all three of these components, individuals can commit to a goal and then continuously and appropriately reduce the gap between the ideal behavior and reality. By comparing their self-monitored results with objective feedback, individuals improve the accuracy of their self-monitoring. When objective feedback matches self-monitoring and reflects progress toward goal attainment, the individual feels more competent and the entire process is reinforced. An optimal self-management process seems to require each of these components.

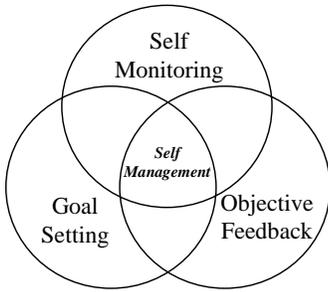


Figure 4. The Self-Management for Safety (SMS) Model.

The vast majority of BBS programs do not lend themselves to solitary workers. Because most employees who operate a vehicle as part of their job duties work alone, there may be substantial benefits from the development of practical self-management techniques for professional drivers. If SMS activities can be integrated with other job activities, safety practitioners will have an effective tool for improving safety-related behaviors that occur when there is little or no opportunity for interpersonal observation and feedback.

5.3.3 Driver Incentive Programs

Incentive programs may be one of the most influential safety management techniques in increasing safety-related driving performance, because economic factors are one of the most important determinants of worker behavior. Since CMV drivers are usually paid by the unit distance (mile or km), not per hour, at-risk behaviors (i.e., speeding, following distance, hours on the road, lack of rest) may, unfortunately, be fostered by economic factors (Wilde, Saccomanno, and Shortreed 1996). An incentive safety program strengthens the motivation for people to behave safely.

Barton and Tardiff (1998) outline the steps needed to develop, administer, and implement an effective incentive program. Some of the critical steps include (a) forming a team to develop and drive the program, (b) proper communication of the rules and benefits to all employees, (c) deciding on the types of rewards, and (d) tracking the program to evaluate effectiveness.

In the survey, 73% of safety manager respondents indicated that they employ driver incentives, but both safety managers and other experts rated incentive systems relatively low in effectiveness (21st and 14th, respectively). As with BBS, many of the pitfalls associated with using an incentive system come from inadequate planning or poor employee buy-in (Barton and Tardiff 1998).

As noted, most incentive programs base their rewards on safety outcomes (i.e., crash-free driving) as opposed to safety behaviors (e.g., speed and headway maintenance). This is a key difference between incentive programs and BBS. A common view among BBS practitioners is that relatively small, yet valuable, incentives are optimal to induce individuals to alter their behaviors and attitudes. The belief is that,

when incentives are kept small, individuals will attribute their behavior change to internal causes rather than external causes. In other words, they will internalize the behavior change. In essence, they say to themselves, “I’m driving the speed limit because I want to be safe—not just to earn a reward” (Geller 2001).

There is also a division among safety professionals as to “what” should be rewarded. While some safety professionals suggest using outcome-based measures (i.e., crash-free miles) in determining rewards (Barton and Tardiff 1998; Barton and Tardiff 2002; Wilde, Saccomanno, and Shortreed 1996), BBS proponents suggest that process-based measures (i.e., specific safety-related driving behaviors) should be used (Geller 2001). They note that, given the relative rarity of crashes and the large role that chance plays in their occurrence, crash involvement may not be the most accurate measure of driver risk.

A difficulty in CMV transport, however, is observing and measuring these safety-related behaviors (Barton and Tardiff 1998; Wilde, Saccomanno, and Shortreed 1996). Two approaches to obtaining such observations are safety placards and on-board monitoring, which are described in the following sections.

5.3.4 Safety Placards

Safety placards are affixed to the rear of trucks or buses and display the driver’s personal identification number and an 800 number that links to the company’s monitoring 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 then 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 (Driver’s Alert 2002; Safety Alert 2002; SafetyNet, Inc. 2002).

The use of safety placards can help fleet safety managers identify risky drivers before a crash, thus allowing for preventative action (retraining and proper instruction of company safety standards) instead of contingent action (reprimand, warning, or termination). Safety placards are effective to the extent they provide objective feedback to the driver about specific safety-related driving behaviors and how to correct them (if a negative action report has been delivered).

Third party monitoring companies offer an affordable and convenient way to monitor commercial drivers. These companies offer many services that in-house monitoring departments may be untrained or unwilling to handle. They also provide the consumer with unbiased personnel.

Most calls received by third party monitoring services are complaints about specific incidents or observed driving behaviors. These services report that the “80–20” rule applies

to the complaint reports within a fleet. That is, most drivers in a fleet rarely receive complaint reports, whereas a relatively small percentage receives the majority (J. Vincent, personal communication 2002; SafetyNet, Inc. 2002; The Fund 1999).

Behavioral safety management emphasizes the value of feedback, but there are several drawbacks in using this type of feedback for commercial drivers. The first, and most obvious, is that drivers will only receive feedback if another motorist makes a call. Second, the accountability and increased attention towards safety the driver initially feels will likely dissipate over time, a term called habituation (Geller 2001). Last, if most of the calls received by third party monitoring services or the company's in-house monitoring department are complaints, the driver is left with the impression he or she will receive only negative feedback (i.e., only discussing at-risk driving behaviors rather than safe driving behaviors).

Yet, several studies, mostly by insurance providers, have researched the efficacy of using safety placards, such as "How's My Driving" stickers, in improving safety in CMVs. These studies have shown significant reductions in vehicle crashes, insurance premiums, and DOT reportable crashes when fleets used safety placards with an effective feedback loop, that is, feedback combined with training and instruction (Johnson 1998; The Fund 1999; STN 1999; Driver's Alert 2002). For example, the Hanover Insurance Co. conducted a study with 11 different trucking fleets ($n = 445$ trucks) using "How's My Driving" safety placards and reported a 22% reduction in crash rate and a 52% reduction in crash costs after 1 year (Johnson 1998).

Given these reported results, it is notable that safety managers and other experts rated safety placards very low in effectiveness (25th and 28th, respectively) as a CMV safety solution. Only 22% of safety managers reported using safety placards with their CMV fleets. Unfortunately, the survey did not discern if safety managers used their own in-house monitoring department or a third party monitoring service. The project team also knows little about the way in which the feedback reports, if any, were used. Feedback, which is also an essential feature of any BBS approach, is critical when using safety placards (see Figure 5). The lack of a reliable and positive feedback loop hinders the effectiveness of safety placards and may be one reason safety managers and other experts rated them relatively low in effectiveness as a CMV safety solution.

5.3.5 On-Board Recording

On-board recording includes two approaches: OBSM of safety-related driving behaviors (e.g., speed, acceleration, braking force), with feedback to drivers and managers and event-data recorders that also monitor driver safety behavior and performance, but which are primarily accessed after a crash or incident to determine and document driver behavior



Figure 5. Feedback loop from an action report. Adapted from SafetyNet, Inc. (2002). www.fleetsafe.com

and vehicle performance just before and during the crash. Some of the vehicle sensors employed in these two applications may be identical, but the safety applications of the information are different.

On-Board Safety Monitoring

In-vehicle technology can be employed to provide continuous, behavioral measures of driving safety, consistent with BBS approaches of behavioral observation, but also potentially serving as a basis for material incentives to drivers to meet safety criteria. Most notably, OBSM technology may be used to focus CMV safety motivational programs on "source" CMV driving behaviors to affect the likelihood of crash involvement (Knipling and Olsgard 2000). A fundamental supposition of industrial safety (see Heinrich, Peterson, and Roos 1980) is that modification of operator behavior parameters to within acceptable bounds will greatly decrease the likelihood of accidents. In other words, the reduction of at-risk behaviors will reduce more serious occurrences (i.e., accidents and injuries).

Many safety-related driving behaviors can be monitored, including driving speed, acceleration (longitudinal and lateral), brake force, location (via GPS monitoring) and driving times (i.e., for HOS compliance monitoring). As noted in Chapter 4, emerging technologies are providing the capability to continuously measure such parameters as forward headway, lane tracking, and even driver alertness. These are all safety process measures that could be employed in a BBS program as the basis for feedback, goal-setting, and rewards for behavioral change. 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, “Establish real-time feedback systems for drivers and define good behaviors and reward mechanisms.”

However, only 36% of safety managers in the survey reported using OBSM, and the effectiveness ratings assigned by both safety managers and other experts were relatively low (18th and 16th, respectively). As discussed in Chapter 4, a major obstacle to more widespread use of OBSM is driver acceptance of these devices. Possible measures to attain greater driver acceptance are (1) addressing driver privacy concerns by giving drivers greater control over the handling and disposition of the OBSM data and (2) emphasizing positive feedback and rewards (including financial rewards) for safe driving behaviors rather than punishments for unsafe behaviors and actions captured by the recording (Knipling and Olsgard 2000).

Ironically, perhaps, safety managers and other experts rated the practice of crash, incident, and violation tracking as highly effective (3rd and 1st, respectively), but they did not highly value the monitoring of the source safety behaviors creating these outcomes. Typically, crashes, incidents, and violations are reported by enforcement agencies or by drivers themselves. This information can be misleading and inaccurate because a crash, violation, or incident is only reported if the driver is caught in the act or reports the incident. OBSM is potentially superior in many respects including the following:

- It can provide objective data on crashes, incidents, and violations, as well as the specific driving behaviors that occurred.

Behavioral Safety Management in a Nutshell

Behavior-Based Safety (BBS) is strongly grounded in behavioral science and proven highly effective in industry applications. The challenge is to apply BBS in the distributed operations of trucking.

BBS Self-Management may be the most effective approach for operations with solitary workers, such as trucking; its key elements include self-monitoring, objective feedback, and goal-setting.

Driver Incentive Programs employ the reward principle and may be effective when well-designed and systematic. However, most programs focus on safety outcomes, whereas behavioral science generally favors focusing on behavior.

Safety Placards provide behavioral feedback to drivers, but are not reliable measures of performance and are perhaps too negative.

On-Board Safety Monitoring is the ultimate in behavioral observation, but the challenges are to win driver acceptance and establish a positive reward system to reinforce desired performance.

- Drivers can receive reports on their successes, rather than receive reports compiled solely on negative events.
- Detailed individual driving statistics can be used to reward drivers for safe driving behaviors (i.e., incentive program).
- OBSM can replace time-consuming ride-alongs.
- It allows drivers the opportunity to receive weekly, and even daily, feedback on their driving performance.
- It can be used to address safety behavior and performance issues before a crash, incident, or violation occurs.

Clearly, OBSM technology and behavioral applications are underused in truck and bus transport in relation to their safety potential.

Event-Data Recorders

Event-data recorders employ many of the same sensors as OBSM, but the key application is different: crash or incident reconstruction. Only 24% of safety manager respondents reported using these devices in their fleets, and they received relatively low ratings for effectiveness by both safety managers and other experts (24th and 26th, respectively). As with OBSM, it is ironic that conventional crash and incident investigation is practiced so widely (83% of safety managers) and rated so highly in effectiveness (5th and 10th, by safety managers and other experts, respectively). For the parameters that they measure, event-data recorders can provide accurate and detailed information to support the crash investigation and provide both managers and drivers with superior feedback regarding possible driving errors leading to the crash.

Like OBSM, event-data recorders have the potential to become a standard and effective tool for improved fleet safety if the driver acceptance issue as well as various other practical and institutional concerns relating to their use can be overcome.

5.3.6 Research and Development Needs

Behavioral safety management has been hugely successful in other industries, but not systematically applied in commercial truck and bus transport. An obvious safety opportunity is to apply and evaluate these methods, determine the most effective practices, and then facilitate its dissemination to the industry. Below are some specific suggested activities:

- Conduct a broad-based, long-term study assessing the efficacy and applicability of using BBS techniques in CMV operations. Based on study findings, develop a standardized manual and a training program for managers addressing the necessary and sufficient techniques to be used in CMV operations.

- Conduct independent, well-designed studies of the benefits and cost-benefits of safety placards, including consideration of how feedback is provided to drivers and how managers conduct corrective follow-up activities.
- Experimentally compare process-based and outcome-based incentive programs to assess which technique is most effective in CMV operations. Develop comprehensive, easy-to-use guides for the fleet management application of techniques found to be the most effective.
- Design safety management applications of OBSM technology to be compatible with behavioral safety management principles. Develop or adapt existing monitoring technologies to support the behavioral safety management system, for example, develop better and easier ways to benchmark good safety performance in terms of the data parameters available from OBSM devices. Test and evaluate this safety technique.

5.4 SAFETY MANAGEMENT PROFESSIONALISM

This section addresses several approaches to elevate the professionalism of motor carrier safety management, including certification of fleet management practices, training and qualifications certification of safety managers, and industry promulgated best practices.

5.4.1 Certification of Fleet Management Practices

Background and Scope

Within the United States, motor carriers that travel across state lines are subject to a regime of mandatory safety regulations relating to vehicles and drivers and are subject to oversight and review by federal and cooperating state officials. These requirements and the associated information systems that record and measure safety performance often influence safety management by fleet operators.

Beyond compliance with governmental requirements, a number of voluntary, management-driven safety management and certification systems and approaches have evolved within the commercial vehicle operations community. These voluntary systems are the focus of this section. The question for future attention is whether such systems can be effective in ensuring safe practices and performance independent of or in conjunction with mandatory, regulatory-driven practices.

Carrier safety management certification processes and programs include the following:

- The International Organization for Standardization ISO 9000 quality certification is likely the most structured of these processes. Although the process does not focus specifically on truck fleet management, overall management practices do have an impact on fleet operations

(Eitah Naveh, Technion and Alfred Marcus, University of Minnesota, personal communication, 2002). A recent evaluation of this program is described in the next subsection.

- The “Responsible Care” program, promoted by the Chemical Manufacturers Association (2002) and affiliated industry associations, is a formal process through which truck and other operations voluntarily participate in audits of activities and practices formally prescribed and published by a unit of the association. The activities are designed to ensure safe handling of hazardous and other toxic materials throughout the life cycle of the products.
- The Canadian Standards Association (CSA) International has developed a carrier safety management certification program. The Carrier Safety Management System (CSA International 2002; Drew 2002) is a voluntary program designed to evaluate and qualify a carrier’s safety management system to an established set of requirements based on CSA International’s B619-00 Carrier Safety Management Systems standard. The standard applies basic management system principles, but from a safety management perspective. To complement this standard, CSA has also designed a qualification program, so that safety management efforts can be audited by an independent third party, CSA International.
- The Military Traffic Management Command, as a supplement to the FMCSA safety rating process, has created a multilevel rating process, more expansive than the FMCSA system. The auditor is Consolidated Safety Services (CSS). Although this process has regulatory underpinnings, it provides an additional benchmark for measuring safety performance in a certification context.
- The TruckSafe Accreditation Program has been developed by the Australian Trucking Association (AusTA) as a voluntary business and risk management system aimed at improving the safety and professionalism of trucking operators. The program includes four standards areas: workplace and driver health, vehicle maintenance, driver training, and management. After entry and compliance audits, the participating fleet is eligible for accreditation by the TruckSafe Industry Accreditation Council, which is an independent body. The AusTA provides support materials for the program.
- Insurance Evaluations. Although these systems are proprietary, many insurance companies and underwriters that support the trucking industry have developed internal evaluation systems that support the risk rating and rate setting processes the companies use in evaluating and insuring carriers.

Effectiveness of Processes and Programs

Information on the effectiveness of safety certification programs is beginning to emerge. A recent analysis of firms

that had implemented ISO 9000 processes, entitled “ISO 9000’s Effect on Accident Reduction in the U.S. Motor Carrier Industry” found that “the safety performance of the ISO 9000 certified carriers was significantly better than the non-certified carriers” (Eitah Naveh, Technion and Alfred Marcus, University of Minnesota, personal communication, 2002). The study compared safety results and other performance results of ISO 9000 certified and non-certified motor carriers before and after certification. It appears that these results flow primarily from the overall ISO 9000 process applicable to all of the carrier firms’ management and operational practices, because no targeted ISO practices approach has yet been developed for truck fleet safety management. The authors note that the main limitation of the data supporting the analysis is that it does not report causation and thus includes the confounding effects of other drivers and vehicles. They also suggest that further investigation is needed to determine the extent to which ISO 9000 contributes to safety improvements, and whether it could lead to the establishment of quality assurance standards for motor carriers. The authors suggest that ISO 9000 could lead to changes in regulations, which could be complemented by reliance on voluntary compliance with ISO 9000 implementation. They also note that, “voluntary ISO 9000 certification does have the potential to alleviate the regulatory burden and improve overall motor carrier safety. However, certification is relatively new in this industry, and companies that have been certified may be unique . . .”

On the effectiveness of TruckSafe, The AusTA (2002), on its website, asserts that “the records of the largest insurer of transport equipment indicate that TruckSafe operators have 40% fewer accidents than non-accredited operators . . .” The AusTA also holds that participation in TruckSafe results in reduced worker compensation costs and reduced maintenance costs.

The CSA Carrier Safety Management Systems Program is relatively new (Drew 2002). CSA supports its potential effectiveness with evidence of positive safety results in other industries where CSA certification is applicable and has recently completed two case studies (CSA International 2002) of carriers that implemented a Carrier Safety Management System as prescribed by standard CAN/CSA B619-00. The case studies indicate that each carrier experienced improvement in quantitative measures obtained from the Commercial Vehicle Operator Registration data after implementation of the Carrier Safety Management System. The measures relate to driver performance, vehicle condition and convictions, and are derived from safety inspections conducted by the Ministry of Transportation. Information on relative improvements in crash rates were not included in the case study summaries.

In the project survey, about one-third of the safety managers claimed to use quality certification of carrier safety management practices. It is likely that the certification experienced by respondents varied from relatively informal inter-

nal or insurance-related evaluations to more formal programs. Effectiveness was not rated high compared to other safety management methods; for safety managers, the mean rating assigned was 18th of 28 methods, and for other experts the mean rating was 17th of 28. These relatively low ratings likely reflect the effectiveness of specific programs safety managers have used and, in the case of other experts, a lack of familiarity with these approaches. The project team believes that safety management certification programs hold significant promise in an overall strategy to improve safety performance of commercial motor carriers. However, the discipline of certification and best practices definition of motor carrier safety systems are in a developmental stage. Even though common elements and approaches are emerging, there is currently no major systematic or visible effort to organize information on the results and relative effectiveness of alternative strategies and tactics, or to apply these programs more widely in the industry.

5.4.2 Certification of Safety Managers

Another approach to enhanced safety management professionalism in CMV transport is professional certification for safety managers. The North American Transportation Management Institute (NATMI, www.NATMI.org) has been affiliated with the ATA. It offers a number of certification opportunities and programs for safety managers, including Certified Director of Safety, Certified Safety Supervisor, Certified Director of Maintenance/Equipment, Certified Supervisor of Maintenance/Equipment, and Certified Driver Trainer. On its website, NATMI asserts that its certification programs measure CMV safety manager “education, experience, and expertise against objective standards that are respected throughout the industry.” NATMI offers safety manager training on such topics as fleet safety management in general, maintenance management, crash investigation, regulatory compliance, and driver training. Steps to certification include completion of required seminars, submission of a formal application, three letters of recommendation, and passing an examination. Admission to each certification program requires certain minimum qualifications; for example, the Safety Director program requires 5 years in the safety field or 4 years plus a 4-year college degree. Candidates must “serve as full-time administrators demonstrating their capability of handling a position which involves establishing programs and policies, setting standards, developing materials, and providing leadership to achieve the goals set.”

Commercial transport trade associations may also offer manager certification programs. For example, the NPTC’s Certified Transportation Professional Program includes a component of safety management in its overall certification of fleet managers as Certified Transportation Professionals.

The survey results for professional “certification of individual fleet safety managers (i.e., professional certificate)”

were similar to those for certification of fleet practices. About one-third of the safety managers claimed to use these programs, but the effectiveness ratings were relatively low for both respondent groups. These relatively low ratings may reflect specific experiences of safety managers and perhaps lack of familiarity by the other experts. The concept of professional certification for safety managers, based on valid and substantive criteria, is a relatively new one. The project team believes that the continued development and promotion of these programs will ultimately result in meaningful improvements in safety manager stature and effectiveness.

5.4.3 Industry-Promulgated Best Practices

Another approach to safety management professionalism is the establishment and promulgation of industrywide best practices, in particular to address known problems and to establish higher standards and greater consistency of professional practice. For some industries, the voluntary establishment of best practices is seen as a way to instill a greater sense of issue “ownership” among practitioners, and perhaps also a way to avoid regulatory or enforcement solutions that might prove more onerous. An example of such an industry-promulgated best practice is the Code of Ethics adopted jointly by the Truckload Carriers Association (TCA) and the National Industrial Transportation League (NITL). The code is entitled, “[A] Voluntary Guide to Good Business Relations for Shippers, Receivers, Carriers, and Drivers.”

Background

Many people involved in commercial motor vehicle transport believe that tight delivery schedules often force drivers to violate HOS or to drive while fatigued. The same factors may lead to violation of highway speed limits, as drivers rush to deliver their cargo on time. This concern was among the top 10 safety issues identified at the 1995 FHWA Truck & Bus Safety Summit and has been the subject of an NTSB recommendation to the FMCSA to initiate rulemaking to prevent such influences on drivers.

Shippers are often cited as the primary party responsible for such influences on drivers, but a 1997 report by the FHWA Office of Motor Carriers (now the FMCSA) (Duke et al. 1997) found, based on a series of focus groups, that “no single player” in the shipping cycle could be held primarily accountable for unreasonable trip scheduling and any resulting unsafe practices. Receivers, shippers, carrier brokers and sales staff, carrier dispatchers, and drivers themselves all contribute to the problem and, potentially, could be involved in reducing it. Economic incentives to drivers for fast delivery may be as strong as demands by various parties for specific delivery times.

A number of factors seem to influence the pressure drivers feel to drive fatigued or violate regulations and traffic laws in making their deliveries. Specific loads may be “rush” based on the needs stated by any of the involved parties. Independent drivers and those with small companies may feel they have fewer resources and less flexibility to turn down or renegotiate jobs requiring tight schedules. Specific types of cargo, such as produce, may frequently require a quick delivery, thus resulting in real or perceived pressure on drivers to compromise safety. However, as noted by the 1997 FHWA OMC study, it appears difficult to assign and document specific responsibility for the problem to parties other than the driver and carrier.

Industry-Based Best Practice

The TCA and the NITL, a trade association representing shippers and receivers, have jointly developed a Code of Ethics for its members and others to address this problem. The code, available on-line at www.nitl.org/guide.htm, is not intended to prescribe industry standards or to create legal rights and responsibilities. Rather, TCA and NITL state that it is in their members’ “mutual interest” to subscribe to the guidelines.

The code consists of 54 specific guidelines. Below are the major categories of the code and the number of specific guideline items under each:

- Shippers/Receivers
 - Treat drivers with courtesy and respect (4 specific items).
 - Ensure that safety practices are followed (10).
 - Foster honesty, fairness, and openness in their dealings with carriers (5).
 - Expedite the movement of equipment (10).
- Carrier Drivers
 - Treat shipping and receiving personnel with courtesy and respect (6).
 - Maintain safe practices (5).
- Carrier Personnel
 - Negotiate honestly with shippers (7).
 - Provide safe and efficient transportation services (7).

The 54 items represent a variety of specific issues too numerous to address here. Some items address business practices such as the negotiation of loads and fulfillment of agreements. A number of items delineate guidelines for workplace practices, including specific loading and unloading practices, parking and queuing protocol, and facilities and amenities available to drivers. An item directly addressing the shipper issue discussed above is as follows: “Shipper/receivers will . . . cooperate with carrier in establishing reasonable transit time requirements so carriers can comply with driver hours of service regulations and speed limits.”

The project team discussed the Code of Ethics with both TCA and NTIL representatives. Their consensus was that the code is in active use and has mitigated these problems. An example of the use of the code is in shipper requests for proposals and subsequent shipping agreements. “Compliance” with the code varies, of course, with larger organizations tending to follow such guidelines more closely, as well as having more closely-prescribed operations in general. The code has, by no means, solved the problems of long waiting times, difficult working conditions, or schedule pressure felt by drivers, but it is a substantive and collaborative effort by the industry to address the problem.

The TCA also unilaterally developed a set of best practices, focusing on loading and unloading waiting times, based on a contracted study (Mercer Management Consulting 2000) of such practices from the carrier perspective. The study report, entitled *“Just in Time to Wait”: An Examination of Best Practices for Streamlining Loading/Unloading Functions*, identifies best practices among shippers, receivers, and carriers for reducing loading dock waiting times, and otherwise expediting freight flow. The report also suggests a number of solutions; and recommends ways to disseminate these solutions within the TCA membership. The study was based on interviews with carriers, drivers, shippers, and receivers, and an examination of more than 100 carrier-shipper contracts to identify contract clauses addressing waiting times and related freight flow issues that might arise in the course of these operations. Among the interesting findings was an “80–20” phenomenon parallel to that described earlier for drivers, that is, a small percentage of the shippers and receivers seem to cause a disproportionate amount of delay and other operational concerns for carriers. A central theme of the solutions offered is that carriers should manage the problem more actively, anticipating and preventing potential problems before they occur. One sensible suggestion was to instill an understanding in everyone involved, including shippers and receivers, that in the long run, unnecessary delays drive up costs for all parties. Thus, carrier-shipper relations should ideally be seen as a partnership for efficient operations.

5.4.4 Research and Development Needs

All three of the practices previously described—carrier certification, manager certification, and industry-based best practices—represent seminal approaches. They all

hold promise but this promise is years from realization. The following are some R&D activities to further these concepts:

- Develop measures of effectiveness for certification and best practices programs. The purpose of this effort would be to create a common evaluation framework for assessing programs, and would include the following:
 - Establishment of an ongoing common disciplinary approach to measurement and evaluation of the relative effectiveness of efforts.
 - Rigorous assessment of evidence for crash-reduction effectiveness of each strategy.
 - Identification of research needed to categorically demonstrate the value of safety certification or adoption of recommended practices.
 - Detailed analysis of safety certification and best practices programs. The focus of this analysis would be development of a structure and topology to track and evaluate these programs. It would include the following:
 - Examination of existing CMV safety certification (carrier and manager) and recommended practices programs, with emphasis on identification of common elements and protocols.
 - Development of a public domain guide to support fleets seeking information on available programs.
 - Evaluation of how certification and best practices programs can supplement or even supplant a range of regulatory and compliance strategies. Should certification and best practices programs prove effective in reducing crashes and injuries, these efforts should be compared to current regulatory programs and the relative effectiveness of each evaluated.
 - Convening of a coordination group for guidance and overall assessment of evolving safety certification and best practices programs. This effort would ensure stakeholder input in evaluating and advancing programs and a greater continuity of effort.
 - Establishment of a professional organization for carrier safety managers that is independent of specific trade associations or industry segments and is dedicated to advancing the stature and professionalism of fleet safety managers and the safety operations of their employers and employees.
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Note: Reference list is incomplete.

APPENDIX A

GLOSSARY

Acronym	Term		
ATA	American Trucking Associations	GPS	Global Positioning System
AusTA	Australian Trucking Association	HOS	Hours-of-service
BAC	Blood alcohol content	LTCCS	Large Truck Crash Causation Study
BBS	Behavior-based safety	LTL	Less-than truckload
BSM	Behavioral safety management	NHTSA	National Highway Traffic Safety Administration
CDL	Commercial drivers license	NPTC	National Private Truck Council
CMV	Commercial motor vehicle	NTSB	National Transportation Safety Board
CTBSSP	Commercial Truck and Bus Safety Synthesis Program	OBSM	On-board safety monitoring
CVO	Commercial vehicle operations	OMC	Office of Motor Carriers [predecessor agency to FMCSA]
FHWA	Federal Highway Administration	TRB	Transportation Research Board
FMCSA	Federal Motor Carrier Safety Administration	UM	University of Maryland
FMCSRs	Federal Motor Carrier Safety Regulations	VTTI	Virginia Tech Transportation Institute

APPENDIX B

PROJECT STATEMENT OF WORK

Effective Commercial Truck and Bus Safety Management Techniques

A rich literature exists regarding military and industrial safety management practices. In the U.S. military, these practices have been formalized as various military standards. In industry, there is a major discipline called “system safety.” Unfortunately, such an extensive body of literature does not exist relating to the management of commercial truck and bus operations and drivers, even though commercial truck and bus driving is an extremely hazardous U.S. occupation. More than 5,000 fatalities occur annually in commercial truck and bus crashes, including more than 700 commercial driver fatalities. Per-vehicle crash costs for tractor-trailers and buses are more than four times those of other vehicle types.

Effective safety management involves a number of diverse practices ranging from equipment management (e.g., preventive maintenance) to driver safety incentive programs. There is a need to examine the full range of approaches possible and describe best practices based on available knowledge. The U.S. DOT Federal Motor Carrier Safety Administration’s Research & Technology Program includes a focus area on “Carrier Compliance and Safety.” This focus area would benefit from a systematic and comprehensive review of the literature and best practice relating to commercial truck and bus safety management.

This synthesis would describe techniques for commercial truck and bus safety management. The synthesis would summarize various safety management approaches and practices applicable to the management of commercial vehicle drivers, trucks, and buses, and would generate hypotheses for new research on commercial truck and bus fleet safety management practices. In addition to summarizing the safety management approaches and practices, the synthesis should include discrete sections on responding to obstructive sleep disorders (e.g., sleep apnea) in safety management; and best practices to ensure the selection of safe, alert, and well-trained commercial truck and bus drivers, including approaches for dealing with drivers with limited English proficiency.

The synthesis should be based on a comprehensive literature review of relevant material, and surveys of and/or interviews with the Federal Motor Carrier Safety Administration, American Trucking Associations Foundation, American Bus Association, Motor Freight Carriers Association, commercial truck and bus carriers with exemplary safety records, insurers of motor carriers, and commercial drivers through contact with organized labor (e.g., International Brotherhood of Teamsters, Amalgamated Transit Union, and United Transportation Union) and the Owner Operator Independent Drivers Association. The hazardous materials-carrying segment of the commercial trucking industry and the scheduled service segment of the passenger bus industry may also be excellent sources of information since crash rates in these segments are known to be generally low. In addition, appropriate DOD agencies may be a relevant source of information.

NOTE: Two years ago the National Industrial Transportation League (NITL) was working on a best practices manual in this subject area for the trucking industry. This manual should be reviewed as an information source for this synthesis.

**APPENDIX C
FLEET SAFETY MANAGER SURVEY FORM**

**Transportation Research Board
Commercial Truck & Bus Safety
Synthesis Program**



CARRIER SAFETY MANAGER SURVEY

Under sponsorship of the Transportation Research Board, the Virginia Tech Transportation Institute (VTTI) is conducting a review and survey of Effective Commercial Truck and Bus Safety Management Techniques. This study is identifying major commercial vehicle operations (CVO) safety management problems of concern, and describing and assessing various approaches to enhanced CVO safety management.

As a fleet safety manager, your knowledge and opinions are of great interest and importance to this study. This survey seeks your input on various CVO safety problems and carrier-based solutions. The survey, which will take about 20 minutes to complete, asks you to rate traffic safety problems in terms of their significance in your organization and carrier-based safety management methods in terms of their potential effectiveness in your organizations' fleet safety. There is also a space for your comments and suggestions. **All survey responses are anonymous and confidential.**

Upon completion of the survey, please mail, fax, or e-mail your form to the VTTI Principal Investigator, Dr. Ron Knipling, at the following address: 7054 Haycock Road, Falls Church, VA 22043, Voice phone: (703) 538-8439, Fax: (703) 538-8450, E-mail: rknipping@vtti.vt.edu.

All survey respondents will receive electronic and hard copies of the study final report, to be published in spring 2003.

This survey form is also available on-line at www.vtti.vt.edu/TRBSurvey.

Safety Management Problem Areas

For each of the following safety problem areas, please indicate the degree to which you agree that the problem area is important in relation to your organizations’ fleet safety. Highly-rated problem areas would be priority concerns for your fleets’ safety management systems. Answer in regard to commercial motor vehicle (CMV) drivers, not other motorists on the highways. **Please read each question carefully and circle the number that best states whether you believe the problem area is important and significant, or not, in your organization. The 5-point scale is: 1=Strongly Disagree (i.e., it’s not very important), 2=Disagree, 3=Not Sure/Neutral, 4=Agree, 5=Strongly Agree (i.e., it’s very important).**

	Strongly Disagree	Disagree	Not Sure/Neutral	Agree	Strongly Agree	Among Top 5?
1. Insufficient training:						
a) Lack of basic driving skills.....	1	2	3	4	5	
b) Poor knowledge of federal, state, and/or company rules.....	1	2	3	4	5	
2. At-risk driving behaviors (e.g., speeding, tailgating).....	1	2	3	4	5	
3. Aggressive driving (i.e., “road rage”).....	1	2	3	4	5	
4. Lack of defensive driving skills (e.g., space management around vehicle).....	1	2	3	4	5	
5. Driver fatigue/drowsiness.....	1	2	3	4	5	
6. Delays associated with loading and unloading (e.g., resulting in long working hours, tight schedules, and fatigue).....	1	2	3	4	5	
7. Alcohol and/or illicit drug abuse.....	1	2	3	4	5	
8. Driver health & wellness problems; specifically:						
a) Lifestyle/general health-related (e.g., poor diet, smoking).....	1	2	3	4	5	
b) Sleep apnea.....	1	2	3	4	5	
c) Cardiovascular illness/heart disease.....	1	2	3	4	5	
d) Prescription drug side effects (e.g., drowsiness).....	1	2	3	4	5	
e) Mental illness (e.g., depression, anxiety, mood disorders).....	1	2	3	4	5	
9. Poor attitude and morale, loneliness, alienation, unhappiness.....	1	2	3	4	5	
10. Driver turnover resulting in unstable workforce.....	1	2	3	4	5	
11. Drivers unfamiliar with routes.....	1	2	3	4	5	
12. Neglect of vehicle maintenance (e.g., brakes, tires).....	1	2	3	4	5	
13. Failure to inspect vehicle (e.g., pre-/post-trip).....	1	2	3	4	5	
14. Unsecured loads.....	1	2	3	4	5	
15. High-risk drivers [all causes combined] (i.e., the degree to which managers should focus on the worst 10-20% of their drivers).....	1	2	3	4	5	
16. Please indicate the five most important problem areas in your organization by placing an “X” next to the item in the Among Top 5? column.						
17. Any additional important problem areas not listed above? Please feel free to comment in the space provided below.						

Safety Management Solutions

For each of the safety management methods or approaches listed below, please indicate **Yes or No**, if your organization currently uses the safety management system. Then, if you indicated your organization currently uses the safety management system (i.e., Yes), indicate your rating of its level of safety effectiveness in your organizations’ fleet safety. In other words, do you believe the safety management method is a viable and effective tool in increasing safety in your organizations’ fleet? **The 5-point scale is: 1=Highly Ineffective, 2=Ineffective, 3=Not Sure/Neutral, 4=Effective, 5=Highly Effective.**

	Highly Ineffective	Ineffective	Not Sure/Neutral	Effective	Highly Effective	Among Top 5?
1. Safe driver recruiting methods						
a) Requiring that new hires meet or exceed a minimum number of years of driving experience YES / NO	1	2	3	4	5	—
b) Hiring based on criteria relating to driver crash, violation, or incident history YES / NO	1	2	3	4	5	—
2. Training standards/programs:						
a) Standardized training for all new hires [e.g., company policy & procedures, customer relations, defensive driving skills, rules for driving (e.g., speeding, headway)] YES / NO	1	2	3	4	5	—
b) Apprenticeship and “finishing” programs for new drivers, conducted by safety manager or senior driver YES / NO	1	2	3	4	5	—
c) Regular refresher training for all drivers YES / NO	1	2	3	4	5	—
d) Remedial training programs for problem drivers YES / NO	1	2	3	4	5	—
3. Regularly-scheduled safety meetings YES / NO	1	2	3	4	5	—
4. Regular safety performance evaluations:						
a) Observation of driving behaviors through ride-alongs YES / NO ..	1	2	3	4	5	—
b) Continuous tracking of driver’s crashes/incidents/violations YES / NO	1	2	3	4	5	—
5. Tracking of overall fleet safety statistics (e.g., fleet crash/violation rate) YES / NO	1	2	3	4	5	—
6. Driver incentive programs for outcome-based safety measures (i.e., reward for crash-free miles) YES / NO	1	2	3	4	5	—
7. Behavior-based safety [i.e., observation, self-observation, feedback, incentives focusing on safety-related driving behaviors (e.g., safety belt use, safe speeds, safe headways)] YES / NO	1	2	3	4	5	—
8. On-board computer monitoring devices <i>with</i> management review, feedback and rewards/punishments for good/poor performance YES / NO	1	2	3	4	5	—
9. On-board computer monitoring (e.g., speed monitoring) and feedback to drivers <i>without</i> management review YES / NO	1	2	3	4	5	—

10.	Event-data recorders (“black boxes”) used to reconstruct crashes and incidents YES / NO	1	2	3	4	5	—
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) YES / NO	1	2	3	4	5	—
12.	“How’s My Driving” placards and 800 numbers YES / NO	1	2	3	4	5	—
13.	Improved communication between drivers and dispatchers regarding scheduling and dispatching to prevent fatigue. YES / NO	1	2	3	4	5	—
14.	Fatigue management programs (i.e., employing fatigue education, sleep disorder screening [e.g., sleep apnea], and “fatigue-conscious” scheduling and dispatching) YES / NO	1	2	3	4	5	—
15.	Fleet-based medical programs:						
	a) Medical screening/counseling (e.g., sleep apnea, cardiovascular) YES / NO	1	2	3	4	5	—
	b) General health & wellness instruction/counseling YES / NO	1	2	3	4	5	—
16.	Preventive maintenance programs:						
	a) Regularly scheduled vehicle inspection and maintenance YES / NO	1	2	3	4	5	—
	b) Trip sheets (driver documentation of pre- and post-trip maintenance inspections) YES / NO	1	2	3	4	5	—
17.	Safety-related equipment on new vehicles:						
	a) Basic equipment (e.g., engine specs, conspicuity lighting) YES / NO	1	2	3	4	5	—
	b) Advanced technology collision avoidance systems (e.g., forward/rear obstacle detection) YES / NO	1	2	3	4	5	—
18.	Within carrier management, alignment of operational and safety functions (e.g., the safety manager is also a direct supervisor) YES / NO	1	2	3	4	5	—
19.	Safety management quality certification programs (i.e., involving outside consultant)						
	a) Certification of carrier safety management practices YES / NO	1	2	3	4	5	—
	b) Certification of individual fleet safety managers (i.e., professional certificate) YES / NO	1	2	3	4	5	—
20.	Please indicate the five most effective safety management methods in your organization by placing an “X” next to the item in the <i>Among Top 5?</i> column.						
21.	Any additional important safety management methods not listed above? Please feel free to comment in the space provided below.						

Respondent Information

1. Approximately how many years have you been a safety manager (for carrier motor operations)?

2. Approximately how many total years experience do you have in commercial vehicle operations?

3. How many power units are currently in your organizations' fleet? _____

4. How would you characterize your fleet's primary operation? Please circle or underline the operation type that best characterizes your fleet:

- For hire: long-haul/truckload
- For hire: long-haul/less-than-truckload (LTL)
- For hire: local/short-haul (most trips less than 100 miles from home base)
- Private industry: long-haul
- Private industry: local/short-haul (most trips less than 100 miles from home base)
- Passenger carrier: long-haul/motor coach
- Passenger carrier: local/transit
- Other: _____

Please mail, fax, or e-mail your survey form to the VTTI Principal Investigator, Dr. Ron Knipling, at the following address: 7054 Haycock Road, Falls Church, VA 22043, Voice phone: (703) 538-8439, Fax: (703) 538-8450, E-mail: rknipling@vti.vt.edu. All respondents will receive a copy of the project final report, to be published in Spring 2003.

Thank you for your participation in this study!

**APPENDIX D
OTHER EXPERT SURVEY FORM**

**Transportation Research Board
Commercial Truck & Bus Safety
Synthesis Program**



COMMERCIAL VEHICLE OPERATIONS SAFETY MANAGEMENT SURVEY

Under sponsorship of the Transportation Research Board, the Virginia Tech Transportation Institute (VTTI) is conducting a review and survey of Effective Commercial Truck and Bus Safety Management Techniques. This study is identifying major commercial vehicle operations (CVO) safety management problems of concern, and describing and assessing various approaches to enhanced CVO safety management.

As an expert in CVO safety, your knowledge and opinions are of great interest and importance to this study. This survey seeks your input on various CVO safety problems and carrier-based solutions. The survey, which will take about 20 minutes to complete, asks you to rate traffic safety problems in terms of their significance and carrier-based safety management methods in terms of their potential effectiveness. There is also a space for your comments and suggestions. **All survey responses are anonymous and confidential.**

Upon completion of the survey, please mail, fax, or e-mail your form to the VTTI Principal Investigator, Dr. Ron Knipling, at the following address: 7054 Haycock Road, Falls Church, VA 22043, Voice phone: (703) 538-8439, Fax: (703) 538-8450, E-mail: rknipling@vtti.vt.edu.

All survey respondents will receive copies of the study final report, to be published in Spring 2003.

This survey form is also available on-line at www.vtti.vt.edu/TRBSurvey.

Safety Management Problem Areas

For each of the following safety problem areas, please indicate the degree to which you agree that the problem area is important in relation to commercial vehicle operations (CVO). Highly-rated problem areas would be priority concerns for carrier safety managers. Answer in regard to commercial motor vehicle (CMV) drivers, not other motorists on the highways. **Please read each question and circle (or otherwise mark) the number that best states whether you believe the problem area is important and significant, or not. The 5-point scale is: 1=Strongly Disagree (i.e., it’s not very important), 2=Disagree, 3=Not Sure/Neutral, 4=Agree, 5=Strongly Agree (i.e., it’s very important).**

	Strongly Disagree	Disagree	Not Sure/Neutral	Agree	Strongly Agree	Among Top 5?
1. Insufficient training:						
a) Lack of basic driving skills.....	1	2	3	4	5	
b) Poor knowledge of federal, state, and/or company rules.....	1	2	3	4	5	
2. At-risk driving behaviors (e.g., speeding, tailgating).....	1	2	3	4	5	
3. Aggressive driving (i.e., “road rage”).....	1	2	3	4	5	
4. Lack of defensive driving skills (e.g., space management around vehicle).....	1	2	3	4	5	
5. Driver fatigue/drowsiness.....	1	2	3	4	5	
6. Delays associated with loading and unloading (e.g., resulting in long working hours, tight schedules, and fatigue).....	1	2	3	4	5	
7. Alcohol and/or illicit drug abuse.....	1	2	3	4	5	
8. Driver health & wellness problems; specifically:						
c) Lifestyle/general health-related (e.g., poor diet, smoking).....	1	2	3	4	5	
d) Sleep apnea.....	1	2	3	4	5	
e) Cardiovascular illness/heart disease.....	1	2	3	4	5	
f) Prescription drug side effects (e.g., drowsiness).....	1	2	3	4	5	
g) Mental illness (e.g., depression, anxiety, mood disorders).....	1	2	3	4	5	
9. Poor attitude and morale, loneliness, alienation, unhappiness.....	1	2	3	4	5	
10. Driver turnover resulting in unstable workforce.....	1	2	3	4	5	
11. Drivers unfamiliar with routes.....	1	2	3	4	5	
12. Neglect of vehicle maintenance (e.g., brakes, tires).....	1	2	3	4	5	
13. Failure to inspect vehicle (e.g., pre-/post-trip).....	1	2	3	4	5	
14. Unsecured loads.....	1	2	3	4	5	
15. High-risk drivers [all causes combined] (i.e., the degree to which managers should focus on the worst 10-20% of their drivers).....	1	2	3	4	5	
16. Please indicate the top five most important problem areas by placing an “X” next to the item in the Among Top 5? column.						
17. Any additional important problem areas not listed above? Please feel free to comment in the space provided below.						

Safety Management Solutions

For each of the safety management methods or approaches listed below, please indicate (circle or otherwise mark) your rating of its potential level of safety effectiveness in carrier safety management. In other words, do you believe the safety management method is a viable and effective tool in increasing safety in commercial fleets? **The 5-point scale is: 1=Highly Ineffective, 2=Ineffective, 3=Not Sure/Neutral, 4=Effective, 5=Highly Effective.**

	Highly Ineffective	Ineffective	Not Sure/Neutral	Effective	Highly Effective	Among Top 5?
1. Safe driver recruiting methods						
a) Requiring that new hires meet or exceed a minimum number of years of driving experience.....	1	2	3	4	5	—
b) Hiring based on criteria relating to driver crash, violation, or incident history.....	1	2	3	4	5	—
2. Training standards/programs:						
a) Standardized training for all new hires [e.g., company policy & procedures, customer relations, defensive driving skills, rules for driving (e.g., speeding, headway)].....	1	2	3	4	5	—
b) Apprenticeship and “finishing” programs for new drivers, conducted by safety manager or senior driver.....	1	2	3	4	5	—
c) Regular refresher training for all drivers.....	1	2	3	4	5	—
d) Remedial training programs for problem drivers.....	1	2	3	4	5	—
3. Regularly-scheduled safety meetings.....	1	2	3	4	5	—
4. Regular safety performance evaluations:						
a) Observation of driving behaviors through ride-alongs.....	1	2	3	4	5	—
b) Continuous tracking of driver’s crashes/incidents/violations.....	1	2	3	4	5	—
5. Tracking of overall fleet safety statistics (e.g., fleet crash/violation rate).....	1	2	3	4	5	—
6. Driver incentive programs for outcome-based safety measures (i.e., reward for crash-free miles).....	1	2	3	4	5	—
7. Behavior-based safety (i.e., observation, self-observation, feedback, incentives focusing on safety-related driving behaviors [e.g., safety belt use, safe speeds, safe headways]).....	1	2	3	4	5	—
8. On-board computer monitoring devices <i>with</i> management review, feedback and rewards/punishments for good/poor performance.....	1	2	3	4	5	—
9. On-board computer monitoring (e.g., speed monitoring) and feedback to drivers without management review.....	1	2	3	4	5	—
10. Event-data recorders (“black boxes”) used to reconstruct crashes and incidents.....	1	2	3	4	5	—
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).....	1	2	3	4	5	—

12. “How’s My Driving” placards and 800 numbers.....	1	2	3	4	5	—
13. Improved communication between CMV drivers and dispatchers regarding scheduling and dispatching.....	1	2	3	4	5	—
14. Fatigue management programs (i.e., employing fatigue education, sleep disorder screening [e.g., sleep apnea], and “fatigue-conscious” scheduling and dispatching).....	1	2	3	4	5	—
15. Fleet-based medical programs:						
a) Medical screening/counseling (e.g., sleep apnea, cardiovascular)...	1	2	3	4	5	—
b) General health & wellness instruction/counseling.....	1	2	3	4	5	—
16. Preventive maintenance programs:						
a) Regularly scheduled vehicle inspection and maintenance.....	1	2	3	4	5	—
b) Trip sheets (driver documentation of pre- and post-trip maintenance inspections).....	1	2	3	4	5	—
17. Safety-related equipment on new vehicles:						
a) Standard safety equipment (e.g., engine specs, conspicuity lighting).....	1	2	3	4	5	—
b) Advanced technology collision avoidance systems (e.g., forward/rear obstacle detection).....	1	2	3	4	5	—
18. Within carrier management, alignment of operational and safety functions (e.g., the safety manager is also a direct supervisor).....	1	2	3	4	5	—
19. Safety management quality certification programs (i.e., involving outside consultant):						
a) Certification of carrier safety management practices.....	1	2	3	4	5	—
b) Certification of individual fleet safety managers (i.e., professional certificate).....	1	2	3	4	5	—
20. Please indicate the five most effective safety management methods by placing an “X” next to the item in the <i>Among Top 5?</i> column.						
21. Any additional important safety management methods not listed above? Please feel free to comment in the space provided below.						

Respondent Information

1. Approximately how many years of professional experience do you have relating to CVO traffic safety?

2. Please circle or underline all experience areas below for which you have 1 year of experience or more relating to motor carrier safety.

- Government enforcement
- Other government (e.g., rulemaking)
- Industry trade association
- CMV driver
- Carrier safety manager
- Accident Investigation/Data Analysis
- Other carrier management position
- CVO safety research
- Journalist
- Driver trainer
- Insurance for motor carriers
- Other _____

Please mail, fax, or e-mail your survey form to the VTTI Principal Investigator, Dr. Ron Knipling, at the following address: 7054 Haycock Road, Falls Church, VA 22043, Voice phone: (703) 538-8439, Fax: (703) 538-8450, E-mail: rknipling@vti.vt.edu. All respondents will receive a copy of the project final report, to be published in Spring 2003.

Thank you for your participation in this study!

APPENDIX E

SAMPLE TOOLS FOR IMPROVED CARRIER SAFETY MANAGEMENT

This appendix contains a variety of safety management tools developed for use by fleet safety managers and CMV drivers. The material in this appendix has been contributed by various fleets, industry trade associations, and insurance companies. The project team and TRB are very grateful to be able to share these fine products with others involved in motor carrier safety.

The specific documents and contributors are described below. They are organized by safety management area.

Employment-Related

1. Employment Process overview and checklist. Developed and distributed by Jim York of Zurich Services Corporation (jim.york@zurichna.com) and provided by the Truckload Carriers Association (TCA) as part of a Truckload Academy guide on *Controlling Accident Costs* (www.truckloadacademy.org).
2. Record of Road Test (given to all new prospective new hires). Developed and provided by D. M. Bowman, Inc.
3. Suggested Minimum Driver Eligibility Criteria for new hires, developed and distributed by Jim York of Zurich Services Corporation (jim.york@zurichna.com) and provided by the Truckload Carriers Association (TCA) as part of a Truckload Academy guide on *Controlling Accident Costs* (www.truckloadacademy.org).
4. Sample Driver Orientation Checklist. Developed and distributed by the Great West Casualty Company.

Training

5. Minimum Training Standards (for drivers with different levels of experience). Developed and provided by D. M. Bowman, Inc.
6. Hazard Recognition Worksheet. Form completed as part of in-service training exercise (accompanied by photos). Praxair Distribution, Inc.

Driving Practices

7. Safety Rules, covering driving, shop, and loading dock practices. Developed and distributed by Flood and Peterson Insurance.

8. “Size Matters” safe driving tips for car and truck drivers, both in English and Spanish. This material was developed by the Colorado Motor Carriers Association and the Colorado Department of Transportation for an outreach/public education program in Weld County, CO. More information on this program is available at www.cmca.com.
9. Winter Hazards—Black Ice (& Dangers de l’hiver—glace noire). Safety poster—English and French versions. Praxair Distribution, Inc.

Driver Performance Monitoring and Evaluation

10. Safety Patrol Observation Record. Developed and provided by D. M. Bowman, Inc.
11. Driver Safety Performance Record. Developed and distributed by Jim York of Zurich Services Corporation (jim.york@zurichna.com) and provided by the Truckload Carriers Association (TCA) as part of a Truckload Academy guide on *Controlling Accident Costs* (www.truckloadacademy.org).
12. Performance Coaching job-aid. Developed and distributed by Jim York of Zurich Services Corporation (jim.york@zurichna.com) and provided by the Truckload Carriers Association (TCA) as part of a Truckload Academy guide on *Controlling Accident Costs* (www.truckloadacademy.org).

Accident Investigation

13. Sample Post-Accident Questions. Developed by Contract Freighters, Inc., and provided by the Truckload Carriers Association (TCA) as part of a Truckload Academy guide on *Implementing an Award-Winning Safety Management System* (www.truckloadacademy.org).

Safety Incentive Program

14. Safe Driving Awards. Program description and award schedule. Developed and provided by D. M. Bowman, Inc.

Vehicle Inspection

15. Getting Ready for Winter! (& Préparez-vous à affronter l’hiver!) Safety poster—English and French versions. Praxair Distribution, Inc.

General—Safety Manager Performance

16. Safety Supervisor “Report Card.” Developed and provided by D. M. Bowman, Inc.

Employment Process

Any Company USA

Employment Phases	Responsible Party	Complete	Date Complete
Phase I: Source of Applicants			
Word of mouth			
Newspaper advertisement			
On-site advertisement			
Walk in			
Phase II: Initial review			
Application materials			
Pre-qualification interview			
Preliminary background check			
MVR (License, endorsements, violation history)			
Experience			
Phase III: In-depth review			
Manager interview			
Employment history			
Criminal history			
Accident history			
Skills assessment (Road test)			
Phase IV: Candidate Evaluation			
Ensure compliance with minimum eligibility criteria			
Skills and abilities			
Character and job attitude			
Phase V: Conditional Employment Offer			
Physical and work abilities test			
Controlled substances (Drug Screen)			
Phase VI: Initial Training and Skills Classification			
Classroom training program			
Additional training assignment (Select appropriate level)			
• Inexperienced			
• Mid-level experienced			
• Extensive experience			
Phase VII: Job Site Training Assignment			
Phase VIII: Job/Supervisor Assignment			
Phase IX: Probationary Employment Period			
Length of initial probationary employment period (90 days)			
Unacceptable behavior/actions			
Required testing/evaluations			
Duty restrictions			
Phase X: Permanent Employment Testing and Evaluation			
Written			
Behind the wheel			
Jobsite			

Driver Name

Manager Name

Date

I certify that all phases of the hiring process were completed in connection with the above named driver

RECORD OF ROAD TEST

Instructions to Evaluator: Enter the applicable demerit points into the space provided next to the item if performance is unsatisfactory. Enter a check mark if the item was performed satisfactorily.

Driver's Name: _____ Driving School: _____

Equipment Driven: Tractor: _____ Trailer: _____

Length of Test: _____ Mi. From _____ To _____

Start Time: _____ Finish Time: _____ Weather Conditions _____

Part 1- PRE-TRIP INSPECTION AND EMERGENCY EQUIPMENT

- Checks general condition approaching unit (5) _____
- Checks fuel, oil, and water level in engine.(25) _____
- Checks around unit- Tires, lights, trailer hookup, brake and light line, doors, and inspects for body damage. (5 ea.) _____
- Checks dashboard warning lights for proper function. (5) _____
- Tests steering, brake action and parking brake. (25) _____
- Checks horn, windshield wipers, mirrors, heater/defrost, fire extinguisher, emergency reflective triangles. (5 ea.) _____
- Checks instruments for normal readings. (5) _____
- Cleans windshield, windows, mirrors, lights, and reflectors(5) _____
- Demonstrate & Use mirror check station _____

PART- 2 COUPLING AND UNCOUPLING

- Couples without difficulty. (5) _____
- Checks coupling by applying hand valve or tractor- protection valve and gently applying pressure by trying to pull away from trailer. (25) _____
- Connects glad hands and light line properly (25) _____
- Visually checks king pin assembly to be certain of proper coupling. (25) _____
- Raises landing gear fully after coupling.(25) _____
- Assure that surface will support trailer before uncoupling. (25) _____

PART- 3 PLACING VEHICLE IN MOTION AND USE OF HAND OF CONTROLS

A. Engine

- Depresses clutch and places transmission in neutral before starting engine. (5) _____
- Maintains proper engine rpm while driving(5) _____
- B. Brakes
- Knows proper use of and checks tractor protection valve. (25) _____
- Tests service brakes. (Fail) _____
- Builds full air pressure before moving. (5) _____
- C. Clutch and Transmission
- Starts unit smoothly. (10) _____
- Double clutches when shifting. (10) _____
- Doesn't force transmission into gear. (5) _____
- D. Lights
- Lights on for safety. (5) _____

PART- 4 BACKING AND PARKING

- A. Backing
- Avoids blind side backing. (25) _____
- Gets out and checks area before backing(10) _____
- Utilizes mirrors properly. (10) _____
- Signals with flashers and horn when backing. (5) _____
- B. Parking
- Backs/Parks without hitting vehicles/objects. (Fail) _____
- Secures unit properly- sets parking brake, transmission in proper gear, and shuts off engine(25) _____
- C. Parking (road)
- Parks vehicle off traveled portion of roadway. (10) _____
- Knows proper application of emergency warning devices and signals. (5) _____
- Carefully enters traffic from parked position (25) _____

PART 5- SLOWING AND STOPPING

- Uses clutch and gears properly.(25) _____
- Selects proper gear before descending hills(5) _____
- Starts without rolling back.(5) _____
- Uses brakes properly on grades. (10) _____
- Plans stop far enough in advance to avoid hard braking. (25) _____
- Comes to a complete stop at all stop signals. (Fail) _____
- Stops clear of crosswalks. (10) _____

PART 6- OPERATING IN TRAFFIC, PASSING AND TURNING

- A. Turning
 - Signals intention to turn well in advance(10) _____
 - Gets into proper lane well advance of turn(10) _____
 - Checks traffic conditions and turns or proceeds only when intersection is clear, regardless of traffic controls. (Fail) _____
 - Restricts traffic from passing on right when preparing to complete right hand turn. (35) _____
 - Completes turn safely, while staying within lanes and not impeding other traffic.(35) _____
 - Completes turn without running over curb.
 - Major- Driver ran over curb aggressively. (Fail) _____
 - Minor- Driver could not safely avoid running over curb. (35) _____
- B. Traffic signs and signals
 - Obeys all traffic signals(Fail) _____
- C. Intersections
 - Enters all intersections prepared to stop if necessary. (25) _____
- D. Grade Crossings
 - Stops at a minimum 15 feet but not more than 50 feet before crossing if stop is necessary.(25) _____
 - Selects proper gear and does not shift gears while crossing. (25) _____
 - Knows and understands federal and state rules governing grade crossing while transporting hazardous materials. (5) _____
- E. Passing
 - Passes only when necessary. (25) _____
 - Passes only when safe and legal to do so. (Fail) _____
 - Signals changing lanes before/after passing. (25) _____
 - Passes with sufficient speed differential to minimize obstructing traffic. (25) _____
 - Returns to right lane promptly but only when safe to do so. (25) _____
- F. Speed
 - Obeys speed limits. (25) _____

- Adjusts speed properly to road, weather and traffic conditions. (25) _____
- Slows appropriately in advance of curves, danger zones and intersections. (25) _____
- Maintains constant speed where possible(25) _____
- G. Courtesy and safety
 - Yields right of way. (Fail) _____
 - Drives defensively and professionally. (25) _____
 - Allows faster traffic to pass.(25) _____
 - Uses horn only when necessary. (10) _____

PART- 7 MISCELLANEOUS

- A. General driving ability and habits
 - Consistently alert and attentive(25) _____
 - Consistently is aware of changing traffic conditions(25) _____
 - Makes proper use of mirrors. (25) _____
 - Anticipates problems(25) _____
 - Performs routine functions without taking eyes from road(25) _____
 - Checks instruments every 10-15 seconds.(5) _____
 - Remains calm under pressure.(25) _____

Comments: _____

Total Demerit points: ____ Pass/Fail (60 demerit points or more fail)

Printed name of Examiner : _____

Signature of Examiner: _____

Date _____



Minimum Driver Eligibility Criteria

Background

In an effort to ensure that the most competent and safe drivers are employed at Any Company USA, the following eligibility requirements must be met by each prospective/current employee seeking/holding a position as a driver of a commercial motor vehicle.

- **Minimum Age:** 21
- **Language:** Must be able to speak and write the English language.
- **Required License:** Must possess or valid driver's license with the applicable endorsements to operate the vehicle within the department to which applicant has applied for employment.
- **Experience:** Must demonstrate a minimum of two years total experience, with at least one year "in-type" (similar to prospective position).
- **MVR Quality:** No more than one conviction for moving violations within the previous 12 months. Not more than two convictions for moving violations within the previous 24 months. No more than three convictions for moving violations in the previous 36 months.
- **Accident History:** No more than one *preventable accident* in the previous 12 months and no more than two *preventable accidents* in the previous 36 months. No more than one *major preventable accident* within the previous 36 months.
- **Disqualifying Offenses:** No applicant may have been convicted for any of the disqualifying offenses defined at 49 CFR Part 383.51 and 383.53 of the Federal Motor Carrier Regulations.
- **Criminal History:** The review committee must review any applicant with a prior criminal history.
- **Physical Qualifications:** Each applicant must meet the requirements defined at 49 CFR Part 391.41 of the Federal Motor Carrier Safety Regulations.

Definitions

Moving Violation: A conviction, which occurred in a commercial or non-commercial motor vehicle for any of the following offenses:

- Speeding: less than 15 mph over the posted speed limit
- Failure to obey traffic control device
- Improper passing
- Improper turn
- Failure to yield right of way

Preventable Accident: An accident, as ruled by the review committee, where the driver failed to do everything that reasonably could have been done to avoid the incident

Major Preventable Accident: A preventable accident arising from a lane change, rear end collision, or intersection incident, which resulted in a fatality, injury requiring treatment away from the scene, or disabling damage (tow away) to any vehicle(s).

Disqualifying Offense: Any of the drug or alcohol or serious traffic violations, committed in a commercial or non-commercial motor vehicle, which are defined at 49 CFR Part 383.51 of the Federal Motor Carrier Safety Regulations. Generally, those violations include:

Drug or alcohol violations

1. Driving while under the influence of alcohol as prescribed by state law
2. Driving while under the influence of a controlled substance
3. Refusing to take a drug or alcohol test

Serious traffic violations

1. Speeding for any speed equal to or greater than 15 mph over the posted speed limit
2. Reckless driving as defined by State or local laws
3. Improper or erratic lane changes
4. Following too closely

Disqualification provisions

Drivers convicted for the ***first Drug or Alcohol violation within the previous five years*** are disqualified for driving for a period of one year.

Drivers convicted for the ***second serious traffic violation within a the previous 36 month period*** are disqualified for driving for a 60 day period.

MINIMUM TRAINING STANDARDS

Experienced Drivers:

Professional drivers with more than one year of verifiable experience will successfully complete the D.M. Bowman, Inc. Orientation Program and hiring process.

Following successful completion of orientation and hiring, the driver must then successfully complete a thorough check ride with a trainer. A thorough check ride will include all evaluations and procedures as outlined.

Limited Experience Drivers:

Drivers with less than one year of verifiable experience will successfully complete the D.M. Bowman, Inc. Orientation Program and hiring process.

After successful completion of orientation and hiring, the driver will be placed in the training program for evaluation. The driver will then complete as many weeks of the training program as the driver trainer may deem necessary.

Inexperienced Student Drivers:

Inexperienced drivers and driving school graduates will successfully complete the D.M. Bowman, Inc. Orientation Program and hiring process.

After the successful completion of orientation and hiring, the driver will be placed in the 6 week training program. Every driving school graduate must have a minimum of 200 hours of behind-the-wheel (BTW) time before being released from training. BTW is time the student is actually driving. The goal is to get the student to 200 hours of driving as quickly as possible. Most students should be able to accomplish this task in 4 to 5 weeks.

On occasion, driver trainers have indicated that, in their opinion, a new driver is qualified to run on his/her own, before he/she has completed all 6 weeks of the program.

In order to consider shortening the training period for the exceptional individual, all of the following criteria must be met:

1. The new driver must have completed at least 4 full weeks of training and must have satisfied the minimum training requirements of the PTDI Skill Standards for the Professional Solo Tractor Trailer Driver.
2. The new driver must have no preventable accidents, incidents, cargo, or worker's comp. claims during the training period.
3. The driver trainer and the new driver must average no less than 2 cents per mile in the speed / idle bonus program.
4. All training items must be complete. If all subjects, topics, evaluations, forms, reviews, etc. have not been completed, then the new driver may not be granted early release until these are accomplished.

Praxair Distribution: Hazard Recognition Worksheet

Name: _____	Employee No.: _____
Location: _____	Location No.: _____
Instructor: _____	Date: _____ / _____ / _____

Title: _____

Scenerio: _____

Potential Hazard	Preventive Action
<p><i>Identify potential hazards in the photograph (Actions or Conditions)</i></p> <p>1. _____</p> <p>2. _____</p> <p>3. _____</p> <p>4. _____</p> <p>5. _____</p> <p>6. _____</p> <p>7. _____</p> <p>8. _____</p> <p>9. _____</p> <p>10. _____</p>	<p><i>List an action that can be taken to eliminate or control the hazard.</i></p> <p>1. _____</p> <p>2. _____</p> <p>3. _____</p> <p>4. _____</p> <p>5. _____</p> <p>6. _____</p> <p>7. _____</p> <p>8. _____</p> <p>9. _____</p> <p>10. _____</p>

Safety Rules

These safety and industrial hygiene rules and instructions are designed to provide you with knowledge of the recognized and established safe practices and procedures that apply to many of the work situations you may encounter while employed at (Joe's Trucking).

To cover every situation would be impossible. If you are in doubt about the safety of any condition, practice or procedure, consult your supervisor for guidance.

Drivers:

1. Drivers must wear seatbelts. Approved passengers must also wear seatbelts.
2. Never jump out of the tractor cab or back of a trailer.
3. When entering and exiting cab, always have three points of contact with your vehicle; two hands and one foot or two feet and one hand.
4. Always use three points of contact when entering or exiting a trailer.
5. During the winter months, always keep sand or kitty litter in your vehicle. Before exiting the cab, it should be applied to the area outside your cab to improve traction.
6. Proper footwear is required, no cowboy boots.
7. Always chock your wheels when positioned at a loading dock.
8. Always chock your wheels when chaining up or performing any maintenance work on your vehicle in the field.
9. Check all wheels for missing lug nuts.
10. No headsets or earphones may be worn while driving.
11. Keep the interior of your tractor free of trash.
12. Avoid sudden or jerky starts or stops. Make allowance for the momentum of the load. Loads must be secure to prevent shifting when emergency action is required.
13. Before negotiating turns, speed shall be reduced to a safe level.
14. A safe distance, approximately three truck lengths, shall be maintained between moving vehicles.
15. When entering a building, stop and look around for possible movement of forklifts, and any other mobile equipment or pedestrians.

Shop:

1. Safety glasses must be worn when working on vehicles.
2. Safety glasses must be worn when performing grinding or sanding operations.
3. Follow designated walkways and aisles while working. Short cuts are dangerous.
4. Walk, DO NOT run.
5. Be alert for moving vehicles and equipment.
6. DO NOT remove, alter or deface any HAZARD WARNING LABEL.
7. NEVER pour FLAMMABLE LIQUIDS down drains or sewers.
8. All employees shall be familiar with, and comply with the OSHA Hazard Communications Standard (HAZCOM) regarding hazardous substances and materials.
9. ALWAYS place hazardous materials in receptacles specially designed for hazardous materials.
10. Watch for black ice around pit area.
11. Obey all smoking regulations.
12. Horseplay, wrestling or throwing any item in play is forbidden while on the job.
13. Before you turn on a machine, make sure that everyone is in the clear, and guards and safety devices are in place and properly adjusted.

14. A neat and clean place to work is necessary for safety. Good housekeeping is an integral part of your job.
15. If you observe something spilled on the floor anywhere that could cause someone to slip or fall, clean it up immediately. If it is impossible for you to clean it up at once, then it is your responsibility to clearly mark or barricade the hazard and report it to the proper authority.
16. If you observe anything that could possibly cause someone to trip or slip on, and it is obviously out of its proper place, pick it up. IF it is something that may not be out of place, report it to the proper authority.
17. Pick up and clean up all scrap and debris that accumulate from work.
18. Return all tools and equipment to their proper storage places when finished with them.
19. Put all trash, paper, waste materials, and oily rags in the proper receptacles.
20. A good job is a clean job and a safe job.
21. Keep tools clean.
22. Check the condition of all tools and equipment before using them.
23. Use the proper tools for the job to be accomplished.
24. Unless you are an electrician, do not attempt any electrical repair.
25. Respect loose or exposed wires.
26. DO NOT touch any exposed or dangling wires that you may encounter; report them to your supervisor.
27. Never lift electrical equipment by the power cord.
28. Never handle energized power cords with wet hands or gloves.
29. Always check all cords for damage before using them.
30. NO tennis shoes, sneakers, jogging type, or other soft sole shoes are allowed on the job.
31. Only substantial heavy-soled gripping shoes or boots may be worn on the job.

All Employees:

1. USE COMMON SENSE!!! Most accidents can be avoided by using common sense and concentrating on the job to be done. Always be aware of your surroundings and what is going on around you. SAFETY IS A FULL TIME JOB!!!
2. It is each employee's responsibility to maintain personal hygiene, particularly when working with hazardous chemicals.
3. Horseplay, wrestling or throwing any item in play is forbidden while on the job.
4. DO NOT remove any lock, tag or flag unless you placed it, and only after you are sure all personnel are in the clear.
5. DO NOT remove any DANGER or CAUTION sign unless you placed it, and then only after you are certain the dangerous condition has been corrected.
6. If a lock, tag or flag must be removed and the person who placed it cannot be found, check with your supervisor who will take the proper steps.
7. Be aware of all articles of clothing, jewelry, or hair that may be in the way of performing your job safely.
8. DO NOT make adjustments to machinery unless you are authorized to do so by your supervisor.
9. KEEP HANDS IN THE CLEAR!!! The only way to assure not losing a hand or finger in a machine is not to place it where moving parts may strike you, or become jammed against a fixed object.
10. Make sure you have the proper hand protection.
11. Obey all NO SMOKING regulations. DO NOT smoke in the immediate area where flammable chemicals or products are being used.
12. All employees shall know the locations of the FIRE EXTINGUISHER and how to use it properly.

Forklift, Pallet Jack and Mule Operation:

1. Keep to the right on aisles while maneuvering pallet jacks or mules.
2. Slow down and proceed with caution at cross aisles, intersections, and turns while operating pallet jacks or mules.
3. Always look to the rear before backing up. Travel forward when possible. If the load you are carrying obstructs your forward view, then travel with the load trailing.
4. Racing, stunt driving or any other form of horseplay is absolutely forbidden, and could be grounds for immediate dismissal.
5. Always keep hands, arms and feet inside the running lines of your equipment.
6. Running over loose objects on the floor shall be avoided.
7. The operator will look in the direction of travel and keep alert.
8. Dock plates between docks and trucks must be sufficiently wide and strong and securely anchored. Truck operators should drive over plates slowly. DO NOT get your truck too close to the edge of the loading dock.
9. DO NOT take a dive. Stay away from the edge of loading docks. One little slip and you can be hurt or killed.
10. NEVER drive into a truck or trailer unless the brakes are firmly set and wheels chocked.
11. Use only those machines that you are qualified and authorized to use.
12. NEVER leave a machine running unattended.
13. Report all unsafe machinery to your supervisor.
14. DO NOT operate any equipment if you feel it is unsafe.
15. DO NOT attempt to brake or slow down moving machinery with your hand or with some make shift device.

I have read and fully understand the company safety rules. I agree to follow these safety rules and report any unsafe conditions or procedures to my supervisor or to the safety committee. I also understand that if I knowingly violate a safety rule and I am injured as a result, I forfeit 50 percent of my workers' compensation benefits.

Signature

Date

(A copy of this signed document will be retained in the employee's personnel file)

Developed by: Flood and Peterson Insurance.



For Safe Driving in Weld County

Safe Driving Tips for Car Drivers

- Don't cut in front of Trucks.
- Stay out of the "No-Zone."
- Avoid Tailgating.
- Wear your seat belt.
- Cut Down on distractions.
- Always drive defensively.

Segerencias para que los automovilistas

- No Corte el paso a los camiones.
- Cuide de no metarse en la "zona prohibida" de un camión."
- No signa demaslado de cerca a un camion.
- Abróchase al cinturón de seguridad.
- No se distraiga.
- Maneje siempre a la defensiva.

Safe Driving Tips for Truck Drivers

- Keep your distance.
- Slow down in work zones.
- Don't drive when tired.
- Be aware of your No-Zone.
- Maintain your vehicle.
- Be professional and work to improve highway safety.

Segerencias para que los camioneros

- Mantenga una distancia prudente.
- Disminuya la velocidad en las zonas donde hay obras
- No maneje el está cansado.
- Preste especial atención a su "zona prohibida."
- Ocúpese del mantenimiento de su vehiculo.
- Tenga una actitud profesional y haga todo lo posible para que las carreteras sean mas seguras.

PDI Distribution



Winter Hazards - Black Ice

Black Ice is a term attributed to a thin and often invisible layer of ice that can potentially form on sections of roads during the cold temperature months. The condition is most prevalent when ambient temperatures drop below 32 °F (0 °C). Contributing factors promoting this condition include:

- Fog or dew condensing on the colder surfaces of bridges, overpasses and shaded areas of roadways.
- Wind-chill or a rapid drop in ambient temperature causing moisture already on the road surface to freeze suddenly.

Potential Signs of Black Ice

A driver should take notice of these conditions which might suggest that Black Ice conditions potentially exist:

- Ice buildup on vehicle windshield, mirrors, wiper blades or antenna.
- When checking mirrors or observing a vehicle in front, there is a sudden reduction in road-spray and the road surface condition looks shiny.
- The presence of road glare from vehicle lights at night.
- Road signs, barriers, trees and fences have icicle formations.
- Feedback from other drivers, the radio or TV weather/road condition reports.

If You Encounter Poor Road Conditions

Do not put yourself at risk, pull over to a safe location and notify your supervisor. Wait until the road conditions improve before continuing your trip. Other defensive actions you can take if you believe there is the potential for Black Ice formation include:

- Reducing vehicle speed to a safer operating level.
- Increasing following distances.
- Planning for longer braking distances.
- Heighten your awareness of the potential reactions and actions of other drivers.
- Practice the "Smith System TM" defensive driving 5 Safety Keys.

Remember.....

Always Drive Defensively and Safely!

Reference:
 DOT/TC Regulations and Safety Codes
 Praxair PDI Driver's Handbook
 POIS Distribution Operating Procedures

Dangers de l'hiver - glace noire

L'expression **glace noire** est utilisée pour décrire une mince couche de glace, souvent invisible, qui se forme sur des sections de la route lors de températures hivernales, surtout lorsque le thermomètre chute sous 0°C. Les facteurs suivants contribuent à sa formation:

- Condensation du brouillard ou de la rosée sur les surfaces les plus froides des ponts et des viaducs et sur les sections ombragées des routes.
- Refroidissement éolien ou baisse rapide de la température causant le gel immédiat de l'humidité présente sur la chaussée.

Signes de glace noire

Le conducteur doit tenir compte des conditions suivantes pouvant signifier la présence de glace noire:

- Accumulation de glace sur le parebrise, les rétroviseurs, les essuie-glaces ou l'antenne.
- Réduction soudaine des éclaboussures des véhicules et route devenant plus luisante.
- Reflets de la route par l'éclairage des phares la nuit.
- Présence de glaçons sur les panneaux routiers, les barrières, les arbres et les clôtures.
- Commentaires d'autres conducteurs, messages sur les conditions routières et rapports météo à la radio et à la télé.

Mauvaises conditions routières

Ne courez pas de risques inutiles; stationnez votre véhicule en lieu sûr et avisez votre superviseur. Attendez que les conditions routières s'améliorent avant de reprendre la route. Voici d'autres mesures défensives à prendre s'il y a risque de glace noire:

- Ralentissez à une vitesse sûre.
- Augmentez la distance entre votre véhicule et celui qui vous précède.
- Prévoyez une plus grande distance de freinage.
- Prévoyez davantage les réactions et les actions des autres conducteurs.
- Mettez en pratique les cinq clés de sécurité de la conduite défensive du <<Système Smith^{MD}>>.

Et souvenez-vous.....

Conduisez toujours défensivement et prudemment!

Référence:

Règlements et codes sécurité du DOT/TC
Guide du conducteur de Distribution Praxair PDI [PDI Driver Handbook]
Manuel POIS - Distribution

D.M. Bowman, Inc. Safety Patrol Observation Report

MONTH _____ DAY _____ YR _____ TIME _____ AM / PM Observer's Code _____

Driver's Name: _____ Observation Location: _____

Tractor # _____ Trailer # _____ Route/Street/Near: _____

<u>Road/Weather (check all that apply)</u>			<u>Direction</u>	Distance Observed _____ miles
clear _____	rain _____	daylight _____	N S	
cloudy _____	ice _____	dawn/dusk _____	E W	Speed Limit _____ Top Speed _____
wind _____	snow _____	nighttime _____		
other _____			<u>Road Grade</u>	Up Down Mixed Level

DRIVER VIOLATIONS (circle) none observed _____

VEHICLE (circle) none observed _____

SPEED
 exceeding posted limit
 exceeding 63 mph
 too fast for conditions
 fail to maintain consistent speed

PASSING
 makes unnecessary pass (short term gain)
 illegal pass (hill, curve, intersection, etc.)
 does not unnecessarily impede faster traffic
 returns to original lane too soon

no / incomplete pre-trip or post-trip
 improper fueling _____
 no "lights on for safety"
 lights (specify) _____
 tires/wheels _____
 placard violation _____
 unicean glass _____
 improperly adjusted mirrors
 vehicle inspection reports complete? _____
 emergency equip _____
 acc report kit / emergency response #
 improper load / securement _____

DIRECTIONAL CONTROL
 weaving / fail to maintain center of lane
 no / improper use of turn signal
 encroachment upon vehicle - side
 encroachment upon vehicle - front
 encroachment - opposing traffic
 unnecessary lane change
 fail to protect inside when turning
 turn causing other to brake to avoid
 fail to slow **before** entering turn
 gets in proper lane early

SPACE MANAGEMENT
 following too closely (maintains min 6 seconds)
 brakes suddenly
 fails to give merging vehicles room
 yields to others in intersection
 fail to slow at uncontrolled intersection

PARKING
 illegally parked
 obstructs others
 parks in high risk location

other (specify) _____

BACKING
 fail to inspect area before backing
 fail to use 4-way flashers
 fail to get out and look
 backing when not necessary
 fail to use all mirrors

DRIVER APPEARANCE: general comments
 uniforms - yes / no _____
 grooming standards violation _____
 medical card, meal card, HM 126f card (all current) _____
 fail to use seatbelt / PPE _____
 failure to use 3 points of contact _____
 unauthorized passenger / pet _____

LOGS
 8 days present? _____

current to last change of duty status? _____

general comments _____

OVERALL COMMENTS _____

ACTION TAKEN / FOLLOW UP _____

Driver Safety Performance Record

Any Company USA

Driver Safety Performance Record

Driver Name:													Terminal Name:												
Safety Incident	Incident Date and Performance Step																								
	<i>Calendar Year: 2002</i>												<i>Calendar Year: 2003</i>												
	Jan.	Feb.	Mar	Apr	Ma	Jun.	Jul.	Aug	Sep.	Oct.	Nov	Dec.	Jan.	Feb.	Mar	Apr	Ma	Jun.	Jul.	Aug	Sep.	Oct.	Nov	Dec.	
Preventable Accident																									
Major Preventable Accident																									
Moving Violation																									
DOT Violation																									
Spill/Contamination																									
Other:																									

Notes to Terminal/Branch Managers:

1. ***Use this form to track the safety record of each employee during a twenty-four month period.***
2. ***Enter the date and "Step Number" in the appropriate year/month box. For example, you were notified that driver John Doe's violation record indicated a speeding (Moving) violation, which occurred on June 25, 2002. This was his first moving violation within a 24 month period. This incident would be entered in the "Moving Violation" row as 25/1 in the June, 2002 grid box.***

Definitions

Preventable Accident:	An accident, as ruled by the review committee, where the driver failed to do everything that reasonably could have been done to avoid the incident
Major Preventable Accident:	A preventable accident arising from a lane change, rear end collision, or intersection incident, which resulted in a fatality, injury requiring treatment away from the scene, or disabling damage (tow away) to any vehicle(s).
Moving Violation	Violations noted in driving record. Examples include: Speeding, failure to obey traffic warning device/sign. Following too closely, unsafe lane change, & etc.
DOT Violations	Other violations of the Federal Motor Carrier Safety Regulations. Examples include: Log violation (False logs, over hours, no/missing logs)
Spill/Contamination	Any unintentional release of product onto the ground. Any "off spec" or improperly placed product.

Performance Coaching

Name:		Employee ID:		Position:	
Date Hired:		Location			

Incident Review

Record the issue or opportunity regarding a specific safety incident noted in the driver's safety performance record. Please provide details and dates:

Intervention Step

Please indicate the appropriate intervention step:

- Verbal (Step One)
- Written (Step Two)
- Decision Making Day (Step Three)
- Termination (Step Four)

Intervention and Action Plan

Part One: Employee

Employee's action plan to resolve the noted safety issue. (To be filled out by the employee). Specifically, the plan must state what you, the employee, intend to do differently, to prevent future occurrences. This portion must be completed for all Step Two and above safety incidents.

Part Two: Supervisor

Supervisor's action plan to resolve the noted safety issue. (To be filled out by the supervisor). Specifically, the plan must state what you, the manager, intend to provide for the employee (e.g., training, information, etc. This portion must be completed for all Step Two and above incidents.

Certification

Employee	Date	Supervisor	Date

Note: All intervention steps are considered active for a 24-month period!

SAMPLE POST ACCIDENT QUESTIONS

(Not necessarily in this order)

CFI

A. General

- 1) Driver name
- 2) Is driver injured
- 3) Co-driver name
- 4) Is co-driver injured
- 5) Was there a passenger on board (i.e. wife, brother, son daughter, etc.)
- 6) Is passenger injured
- 7) Number of vehicles involved
- 8) Exact location of accident
- 9) Date and time of accident
- 10) Date and time reported to company
- 11) Weather and road conditions
- 12) General description of accident

B. DOT recordable information

- 1) Is there a fatality involved
- 2) Were any vehicles towed from the scene
- 3) Where any person at the scene transported due to injuries
- 4) Did your driver receive a ticket
- 5) Is there a Post Accident Drug/Alcohol Test required

C. Property damage (other than vehicles)

- 1) What was damaged
- 2) Who owns the property (Name, address, phone)
- 3) Location of the property damage
- 4) Is it causing loss of business (i.e. power outage, etc.)

D. Law Enforcement

- 1) Name, badge number and department of investigating officer

E. Load Information

- 1) How long had the driver been driving since their last 8 hour break
- 2) Is there a load involved
- 3) What type of cargo is involved
- 4) Destination and origin of the load
- 5) Was there cargo damage
- 6) Was there a Hazardous Material Spill

F. Vehicle information for each vehicle involved

- 1) Name, address and phone of driver and each passenger in the vehicle
- 2) Were any person in this vehicle injured
- 3) Vehicle year, make, model and license
- 4) Type of damage
- 5) Insurance company name, address and phone
- 6) Was the driver ticketed

G. Injury information for each person involved

- 1) Name
- 2) Type of injury
- 3) Where were they taken (i.e. Hospital)
- 4) Address and phone of location taken

H. Witness information

- 1) Name, address, phone, cell phone, email address or any other information



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Safe Driving Awards

- Eligibility:** All full-time drivers are eligible to receive these awards. Drivers must have driven at least 11 of the 12 months of the safety year (orientation and training weeks are considered towards eligibility in addition to driving time) to receive an award. If a driver is on leave at the time the award is presented but worked at least 11 months during the safety year he or she will still receive his or her award. A safety year begins with a driver's hire date and runs for one year from that date. The safety year will vary from driver to driver.
- Program Goal:** This program is designed to encourage full-time drivers to focus on safety and to eliminate preventable accidents, incidents and Workers' Compensation claims.
- Program Summary:** This program rewards full-time drivers who drive safely for a one-year safety period and who do not have a preventable accident, incident or Workers' Compensation claim.
- Program Award:** Drivers can earn different awards based on the number of years and/or miles driven safely. See the attached schedule of awards.
- All awards are presented at the Spring Safety Breakfast.
- Disclosures:** The award recipient must be on active status at the time the award is presented in order to receive the award. The value of these awards is not considered compensation and is not subject to taxes, except for the cash award. The cash award is subject to taxes, but is not considered compensation for the 401(k) Plan or the Profit Sharing Plan. D. M. Bowman, Inc. reserves the right to change this program, or to discontinue this program, at any time.

Safe Driving Award Program – Award Schedule

EACH SAFE DRIVING YEAR

- ATA patch, lapel pin, wallet card with drivers name and number of safe driving years.

Additionally, awards are distributed for the following designated number of safe driving years:

1 YEAR

- Bronze Bowman truck belt buckle with belt buckle attachment
- Bronze medallion and pin with limited edition scene

2 YEARS

- Belt buckle attachment with years of safe driving.
- Bronze medallion and pin with limited edition scene.

3 YEARS

- Belt buckle attachment with years of safe driving.
- Bronze medallion and pin with limited edition scene
- Vest embroidered with safety logo, driver name, terminal and years of safe driving.
- Name, years of safe driving, and any special honors (Million mile club, Hall of Fame, State Road Team) placed on truck door.
- Small, wooden, felt lined medallion display board

4 YEARS

- Belt buckle attachment with years of safe driving.
- Bronze medallion and pin with limited edition scene
- Name, years of safe driving, and any special honors placed on truck door.

5 YEARS

- Silver Bowman truck belt buckle
- Belt buckle attachment with years of safe driving.
- Silver medallion and pin with limited edition scene
- Jacket embroidered with safety logo, driver name, terminal and years of safe driving.
- Name, years of safe driving, and any special honors placed on truck door.

6 to 9 YEARS

- Belt buckle attachment with years of safe driving.
- Silver medallion and pin with limited edition scene
- Name, years of safe driving, and any special honors placed on truck door

10 YEARS

- Gold Bowman truck belt buckle
- Belt buckle attachment with years of safe driving.
- Gold watch with Bowman truck on face.
- Gold medallion and pin with limited edition scene.
- Jacket embroidered with safety logo, driver name, terminal, and years of safe driving.
- Name, years of safe driving, and any special honors placed on truck door.
- Large, wooden, felt lined medallion display board.

11 to 14 YEARS

- Belt buckle attachment with years of safe driving.
- Diamond attached to gold watch.
- Gold medallion and pin with limited edition scene
- Name, years of safe driving, and any special honors placed on truck door.

15 YEARS

- Ring with a green stone
- Belt buckle attachment with years of safe driving.
- Gold medallion and pin with limited edition scene and diamond attachment.
- Jacket embroidered with safety logo, driver name, terminal, and years of safe driving.
- Name, years of safe driving, and any special honors placed on truck door.

16 to 19 YEARS

- Diamond set in ring around green stone for each year of safe driving.
- Belt buckle attachment with years of safe driving.
- Gold medallion and pin with limited edition scene and diamond attachment.
- Name, years of safe driving, and any special honors placed on truck door.

20 YEARS

- Diamond set in center of ring (green stone is cut out and .25 pt diamond inserted.)
- Belt buckle attachment with years of safe driving.
- Gold medallion and pin with limited edition scene and diamond attachment.
- Jacket embroidered with safety logo, driver name, terminal, and years of safe driving.
- Name, years of safe driving, and any special honors placed on truck door.

21-24 YEARS

- Gold medallion and pin with limited edition scene and diamond attachment.
- Belt buckle attachment with years of safe driving.
- Name, years of safe driving, and any special honors placed on truck door.

25 YEARS

- Jacket embroidered with safety logo, driver name, terminal and years of safe driving.
- Name, years of safe driving, and any special honors placed on truck door.
- Belt buckle attachment with years of safe driving.
- Gold medallion and pin with limited edition scene and diamond attachment.
- \$1000.00 check

30 YEARS

- \$1500.00 check

35 YEARS

- \$2000.00 check

40 YEARS

- \$2500.00 check

MILLION MILE DRIVER

- Drivers who have driven one million miles with D.M. Bowman, Inc. receive a black satin jacket embroidered with a Bowman truck, drivers name, terminal, years of safe driving and Million Mile Club.
- Name, years of safe driving, and any special honors placed on truck door.

HALL OF FAME

- Drivers with one million miles of consecutive safe driving receive a three in one black jacket embroidered with a Bowman truck, the driver's name, terminal, years of safe driving, Million Mile Club and Hall of Fame.
- Plaque engraved with name, terminal, and the date inducted into the Hall of Fame.
- A one time check, net, of \$1000.00.
- Name, years of safe driving, and any special honors placed on truck door.
- Photograph and name added to the "wall of fame" at the D.M. Bowman Professional Development Center.



Safety Poster

Getting Ready For Winter!

Advanced planning for winter or foul weather conditions helps reduce the risk of being caught unprepared.

The following are helpful hints for facility and vehicle preparation:

Facility Preparation

- Confirm all required contractor services and review agreement terms and conditions.
- Conduct contractor safety training.
- Inspect furnace operation and change all required filters.
- Assign employees to specific winter or foul weather maintenance tasks.
- Review all emergency contingency plans.
- Ensure all driveway markers and premise lighting are in good condition.
- Keep replacement "dry" rugs and runners beside door entrances.
- Verify all winter or foul weather equipment or provisions (shovels, mops, ice-melt, sand, etc.)

Vehicle Preparation

- Include winterization and foul weather protection as part of the vehicle preventive maintenance program. (Tires, cooling system, fluid levels, battery, block heaters, wiper blades, heaters/defrosters etc.)
- Inspect and replenish all vehicle emergency equipment. (May include shovels, tire chains, sand, etc.)
- Provide for emergency communication for out-of-town travel. (Cell phone, 2-way radio)

Maintain a "Weather Watch"!

Check weather condition reports frequently. Advanced planning will reduce winter hazards and foul weather risk.

Reference:
Praxair Safety Policy Manuals

Préparez-vous à affronter l'hiver!

Une bonne préparation à l'hiver ou aux intempéries contribue à réduire le risque d'être pris au dépourvu.

Voici des conseils utiles pour la préparation des installations et des véhicules:

Préparation des installations

- Confirmer tous les services requis avec les entrepreneurs et revoir les conditions des contrats
- Donner une formation sur la sécurité aux entrepreneurs.
- Inspecter l'état de la chaudière et changer tous les filtres au besoin.
- Assigner aux employés des tâches d'entretien relatives à l'hiver ou aux intempéries.
- Revoir tous les plans d'urgence.
- S'assurer que tous les indicateurs d'allée et l'éclairage sont en bon état.
- Garder des carpettes et des protecteurs de remplacement <<secs>> près des entrées de porte.
- Vérifier tout l'équipement d'hiver ou pour les intempéries et les provisions (pelles, vadrouilles, sel de dégel, sable, etc.)

Préparation des véhicules

- Inclure la préparation des véhicules pour l'hiver et les intempéries dans le programme d'entretien préventif des véhicules. (Pneus, système de refroidissement, niveaux des liquides, batterie, chauffe-moteur, essuie-glaces, chaufferette et dégivreur, etc.)
- Inspectez et se procurer les éléments manquants de l'équipement d'urgence, par exemple pelles, chaînes à neige, sable, etc.
- Prévoir des moyens de communications d'urgence pour les voyages hors de la ville (téléphone cellulaire, poste émetteur-récepteur, etc.)

Maintenir une <<Veille météo>>!

Vérifier fréquemment les rapports météorologiques. La prévoyance contribuera à réduire les dangers reliés à l'hiver et aux intempéries.

Références:

Manuels des politiques de sécurité de Praxair

Safety Supervisor "Report Card"

ITEM	COLOR	RANGE
FREQ/MM	WHITE	Goal
	YELLOW	1 whole claim over goal total equivalent
	RED	More than 1 whole claim over goal total equivalent
\$/MILE	WHITE	.0200 or better
	YELLOW	.0201 - .0250
	RED	.0251 or above
PRE-HIRE SAFETY SCREENING (on time & complete file at corp. by 1st day of orientation & (criminal record excluded) all information included and within limits of company policies unless authorized)	WHITE	100% drivers 100% complete
	YELLOW	90%-99.9% drivers 100% complete
	RED	Below 90% of drivers 100% complete
TRAINING PROGRAM ADMINISTRATION (all previous week training data entered before noon of Tuesday of following week)	WHITE	100% trainees 100% updated on time
	YELLOW	95%-99.9% trainees 100% updated on time
	RED	Below 95% trainees 100% updated on time
NEW-HIRE EDUCATIONAL SERIES ADMINISTRATION	WHITE	100% drivers complete by due dates
	YELLOW	80%-99.9% drivers complete by due dates
	RED	Below 80% of drivers complete by due dates
SAFETY ALERT ADMINISTRATION	WHITE	100% drivers complete by end of period
	YELLOW	90% - 99.9% complete by end of period
	RED	Below 90% of drivers complete by end of period
SAFETY IMPROVEMENT TEAM ADMINISTRATION	WHITE	GOAL (ytd cumulative)
	YELLOW	Goal -1
	RED	> 1 below goal
COMPLIANCE TRAINING (deadline to have HM126F certificate to corporate 1 month prior to actual expiration date)	WHITE	100% employees trained by due dates
	YELLOW	95%-99.9% employees trained by due dates
	RED	Below 95% employees trained by due dates

ITEM	COLOR	RANGE
ON-TIME DEPARTURES	WHITE YELLOW RED	100% & above on time 99% - 95% on time Below 95% on time
ROAD PATROLS (SS observes driver, fills out report, covers in-person with driver, documents in RMIS with date of observation)	WHITE YELLOW RED	5% or more of drivers observed 1%-5% of drivers observed 0 drivers observed
COMPANY SPEED POLICIES (redline & 70 mph)	WHITE YELLOW RED	100% drivers within limits - no redlining or hitting 70 mph (total) 88%-99.9% drivers within limits - no redlining or hitting 70 mph (total) Below 88% drivers within limits - no redlining or hitting 70 mph (total)
CLAIM ANALYSIS (within time limits - 72 hrs linehaul, 48 hrs shorthaul) (face-to-face meeting with driver, ruled for preventability, analyzed for root cause, communique completed - even if Under Investigation)	WHITE YELLOW RED	100% claims ruled, analyzed, & documented (w.t.l.) 85% - 99.9% claims ruled, analyzed, & documented for root cause (w.t.l.) Below 85% claims ruled, analyzed, & documented (w.t.l.)
POST CLAIM RETRAINING (beginning within time limits - 72 hrs linehaul, 48 hrs shorthaul, minimum level video & post test & attached to communique)	WHITE YELLOW RED	100% retained drivers with preventable claims retrained (w.t.l.) 85% - 99.9% retained drivers with preventable claims retrained (w.t.l.) Below 85% retained drivers with preventable claims retrained (w.t.l.)
LOG VIOLATIONS/FALSIFICATIONS (letter of reprimand or correction to log audit within 30 days of occurrence)	WHITE YELLOW RED	100% letters or corrected logs to log audit (w.t.l.) 95%-100% letters or corrected logs to log audit (w.t.l.) Below 95% letters or corrected logs to log audit (w.t.l.)
RANDOM D&A TEST ADMINISTRATION (deadline to have results to corporate - 14 calendar days)	WHITE YELLOW RED	100% of due to corp by deadline 99%-90% of due to corp by deadline below 90% of due to corp by deadline
DOT PHYSICAL & CDL RENEWAL (deadline to have copy of renewed document to corporate - actual expiration date of previous)	WHITE YELLOW RED	100% of due to corp by deadline 99.9%-85% of due to corp by deadline below 85% of due to corp by deadline

ITEM	COLOR	RANGE
CLAIM ENTRY (timely & accurate - within 12 hours of claim, with correct driver and equipment numbers)	WHITE	100% claims 100% accurate 100% within 12 hrs
	YELLOW	85%-99.9% claims 100% accurate 100% within 12 hrs
	RED	Below 85% claims 100% accurate 100% within 12 hrs
WEEKLY WORK COMP FOLLOW-UP (1 phone call per week to employee - with contact)	WHITE	100% contact made
	YELLOW	100% - 90% contact made
	RED	Below 90% contact made

PERFORMANCE RANKING SYSTEM

0-45	VERY GOOD
45-90	GOOD
90-120	AVERAGE
120-180	POOR
180-270	VERY POOR

Notes

Abbreviations used without definitions in TRB publications:

AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
IEEE	Institute of Electrical and Electronics Engineers
ITE	Institute of Transportation Engineers
NCHRP	National Cooperative Highway Research Program
NCTRP	National Cooperative Transit Research and Development Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
SAE	Society of Automotive Engineers
TCRP	Transit Cooperative Research Program
TRB	Transportation Research Board
U.S.DOT	United States Department of Transportation