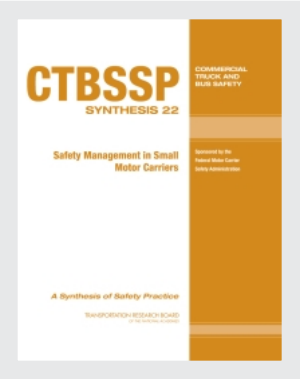


# Safety Management in Small Motor Carriers

**DETAILS**

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COMMERCIAL TRUCK AND BUS SAFETY SYNTHESIS PROGRAM

CTBSSP SYNTHESIS 22

# Safety Management in Small Motor Carriers

## *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 underevaluated. 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.

## CTBSSP SYNTHESIS 22

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The members of the technical committee selected to monitor this project and to review this report were chosen for recognized scholarly competence and with due consideration for the balance of disciplines appropriate to the project. The opinions and conclusions expressed or implied are those of the research agency that performed the research, and, while they have been accepted as appropriate by the technical panel, they are not necessarily those of the Transportation Research Board, the National Research Council, or the Federal Motor Carrier Safety Administration of the U.S. Department of Transportation.

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**ACKNOWLEDGMENTS**

Many individuals and organizations contributed to this research project. Fundamental information was provided by the survey respondents, both carrier safety managers and other experts. Ten carrier owners–managers also participated in interviews regarding their carrier's priority safety problems and safety management methods. Because the surveys and interviews were anonymous, participants cannot be identified and thanked individually. The project team and TRB are grateful to all respondents for taking the time to provide information and expert judgments to support the project.

The University of Minnesota, Morris, under the supervision of Dr. Stephen V. Burks, Associate Professor of Economics and Management, supported the project literature review, other information gathering, and manuscript development. MaineWay Services, Inc., was the prime contractor.

The project team is grateful to five commercial motor vehicle industry associations that supported the safety manager survey by soliciting member participation in the online survey. This project would not have been possible without the active support of these organizations:

- American Bus Association (ABA)
- Bus Industry Safety Council (BISC)
- National Association of Small Trucking Companies (NASTC)
- Owner–Operators Independent Drivers Association (OOIDA)
- United Motorcoach Association (UMA).

Other organizations providing information on ongoing or recent research or other programs included:

- American Transportation Research Institute (ATRI)
- American Trucking Associations (ATA)
- Federal Motor Carrier Safety Administration (FMCSA)
- TRB Committee on Truck and Bus Safety Research (ANB70)
- TRB Committee on Trucking Industry Research (AT060)
- Volpe National Transportation Systems Center.

## FOREWORD

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 underevaluated. 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 the subject 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 problems.

The CTBSSP, administered by the Transportation Research Board, was authorized in late 2001 and began in 2002 in support of the FMCSA's safety research programs. The program initiates several synthesis studies annually that address issues 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.

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 practices have been used for solving or alleviating problems; (3) to identify relevant, 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.

## PREFACE

*By Donna L. Vlasak*
*Senior Program Officer*
*Transportation Research Board*

The goals of this synthesis were to identify (1) useful practices for safety management in small companies and (2) a logical and practical progression to more active and comprehensive safety management for small companies as they grow. The report explores small motor carrier strengths and weaknesses and identifies potentially effective safety practices. It found that each company's safety outcomes are more reflective of its own safety practice and operating environment than whether it is large or small. The audience for this study includes small motor managers, as well as government and industry officials.

This report reviewed research on motor carrier safety, safety management, and organizational management, in general. Literature review searches were performed using websites, academic databases, books, trade press publications, and articles. In addition, members and friends of TRB Truck and Bus Safety and Trucking Industry Research

Committees, FMCSA Analysis Division, and the U.S.DOT Volpe National Transportation Systems Center provided materials.

The project survey of five truck and bus industry trade associations' members was a convenience sample of individuals judged qualitatively to best represent the target population and whose support was critical to the success and validity of the work. Organizations included the American Bus Association (ABA), Bus Industry Safety Council (BISC), National Association of Small Trucking Companies (NASTC), Owner–Operator Independent Drivers Association (OOIDA), and the United Motorcoach Association (UMA). These survey respondent groups (112—79 truck and 33 bus) of interested, knowledgeable individuals provided indications of industry thinking from different perspectives.

A select group of ten small motor carriers' were interviewed for confidential case studies on safety management problems and practices. These ten provided substantial information on innovative small carrier safety practices.

Ronald R. Knipling, Safety for the Long Haul, Arlington, Virginia, and Kenna C. Nelson, University of Minnesota at Morris, with the support of Gene Bergoffen, MaineWay Services, Inc., Fryeburg, Maine, and Stephen V. Burks, University of Minnesota at Morris, collected and synthesized the information and wrote the report. The Commercial Truck and Bus Safety Synthesis Program Oversight Committee members are acknowledged on the preceding page. This synthesis is an immediately useful document that records the practices that were acceptable within the limitations of the knowledge available at the time of its preparation. As progress in research and practice continues, new knowledge will be added to that now at hand.

# CONTENTS



Note: Many of the photographs, figures, and tables in this report have been converted from color to grayscale for printing. The electronic version of the report (posted on the Web at www.trb.org) retains the color versions.

# SAFETY MANAGEMENT IN SMALL MOTOR CARRIERS


## SUMMARY

This report synthesizes current information on safety management in small motor carriers (commercial truck and bus companies) in North America. The report provides information to assist small motor carriers in improving their safety performance. The goals of the study are: (1) to identify useful practices for safety management in small companies, and (2) to outline a logical and practical progression to more active and comprehensive safety management for small companies as they grow.

Small companies are defined here as those with more than one driver, but with too few drivers and vehicles to afford to designate a manager with the primary title and function of Safety Manager. Furthermore, these are companies where there is a company owner/manager who drives less than 50% of the time (i.e., is not primarily a driver) and who performs most management and supervision tasks, including those relating to safety and compliance. Most of these carriers have 5 to 20 vehicles.

In general, project information was obtained through reviews of research on motor carrier safety, safety management, and organizational management. Additional information was gathered from government and industry experts. The project also acquired information from motor carrier managers who were surveyed with regard to safety management problems and practices. The report includes ten case studies of small carriers' safety management practices. It also reports research and development needs as they came to light during the study.

The following five truck and bus industry trade associations participated in the study by forwarding the project survey request to their members and by providing other information and support.

- American Bus Association (ABA)
- Bus Industry Safety Council (BISC)
- National Association of Small Trucking Companies (NASTC)
- Owner–Operator Independent Drivers Association (OOIDA)
- United Motorcoach Association (UMA).

This support was critical to the success and validity of the work.

The project survey of motor carrier managers was a judgment sample rather than a nationally representative, probability-based sample. That is, the sample was a convenience sample of responding managers who were members of national trade associations judged qualitatively to best represent the target population. Survey results should not be inferred as representative statistical profiles of North American motor carriers or any other larger population. Nevertheless, the survey provided valuable insights into the views and practices of small carrier managers.

Information gathered in the project literature review, survey, and other activities is presented in the following organization structure:

- Business, operational, and safety management in small companies;
- Small company violation and crash rates;

- Vehicle equipment and maintenance;
- Operational planning and risk avoidance;
- Driver hiring;
- Driver orientation, training, and communications;
- Driver supervision;
- Crash and incident investigation;
- Carrier performance tracking and benchmarking;
- Management development; and
- Comprehensive safety management approaches.

From a safety perspective, small carriers have some advantages over larger carriers. Small carrier managers have direct contact almost every day with their drivers, other employees, and vehicles. They can closely monitor all carrier operations; there are no layers in their management structures. Small carriers tend to have relatively low driver turnover rates, perhaps reflecting closer personal relationships within small companies than in large ones. Two major disadvantages are the relative lack of resources (e.g., to buy new safety equipment) and a lack of specialized management (e.g., driver recruiters, trainers, and crash investigators). Small carriers can generally improve their safety performance by adopting practices seen more commonly in larger companies, while retaining small company strengths, if possible. This report identifies 27 management practices with evidence of safety effectiveness.

Research to find new knowledge and development efforts toward new tools could contribute to more effective safety management in small companies. Several research needs are identified to address unanswered questions about small carrier safety. Suggested development projects could produce management software, training programs, or other products to aid small companies.

CHAPTER ONE

# INTRODUCTION

> "It is all about having/hiring the right people who have the right attitude. Then monitoring their progress helps keep them on track."
>
> "Don't get so big that the owner does not know every person on payroll and make it their business to personally check out every driver every day! Big companies are a big problem when they look only for income and not their relationship with those who provided it."
>
> "Vehicle safety equipment is more often than not too costly for small carriers to obtain in today's economy."
>
> "The problem I see is for small carriers trying to keep up with all the changes and regulations that are taking place."
>
> "Most owner operators and small fleet operators do a good job of maintenance and safety but are lacking in the back-up aspects such as paper work."
>
> "The problem I see is for small carriers trying to keep up with all the changes and regulations . . ."
>
> The "stupid things [other motorists] do . . . create a hazard and put myself and other motorists in danger . . . anything can happen out there."
>
> "In many companies, the owner wears many hats. Safety is only one and deciding where to expend your time and resources is a struggle every small company has."

These statements were made by small motor carrier owners/managers in the survey and in interviews conducted for this synthesis study. This study explores the safety management problems faced by small companies and the safety management approaches they consider most useful. In addition to conducting the survey and interviews, the project team performed a research literature review of small company management, with emphasis on motor carrier safety management. The goals of the study are to (1) identify useful practices for safety management in small companies, and (2) outline a logical and practical progression to more active and comprehensive safety management for small companies as they grow.

## BACKGROUND

This study addresses Commercial Motor Vehicle (CMV) transport companies with a relatively small number of vehicles and drivers. Unified Carrier Registration (UCR) data (FMCSA 2010) yielded the following breakdown of U.S. motor carriers by fleet size:

- One (1) vehicle: 44.8%.
- 2–5 vehicles: 32.5%.
- 6–20 vehicles: 15.0%.
- 21–100 vehicles: 4.0%.
- 101–1,000 vehicles: 0.6%.
- 1,001+ vehicles: 0.1%.

The total number of small U.S. truck and bus companies is difficult to discern because both the UCR and the Motor Carrier Management Information System (MCMIS) contain numerous inactive carriers. In addition, many registered carriers are not primarily in the transport business, but instead are private companies that operate one or more trucks or buses secondarily in support of their core business (manufacturing, retail, services, etc.). Regardless of these caveats, it is safe to say that the vast majority of U.S. carriers are small, running 20 vehicles or less. The same UCR data revealed that there are approximately 200,000 motor carriers in the 2 to 20 vehicle range, although the number of active carriers may be just half of that. Regardless, there are tens of thousands of small motor carriers in the United States that must operate their vehicles safely and in compliance with federal and state regulations, while staying financially viable.

Several different definitions of "small carrier" are possible. According to Small Business Administration criteria, a "small entity" is a company with annual revenues of less than $25.5 million. This translates to an average of 128 power units based on current economic analysis (FMCSA 2010). However, this number of vehicles is far greater than that of the typical small carrier. Rather than choosing an arbitrary number of power units to define "small carrier," this project has been based on a functional definition relating to company management structure. Small carriers are defined here as those with more than one driver and vehicle (thus excluding owner–operators), but with too few drivers and trucks to afford to designate a manager with the primary title and function of Safety Manager. These are companies where a single owner/manager performs most or all management tasks, including those relating to safety. Further, he or she is not primarily a driver (i.e., drives less than 50% of the time), but is primarily a manager. E-mail solicitations to participate in the project survey were sent to broader groups of carrier owners/managers; however, the results presented in this report are limited to those meeting this definition. In the survey, the average carrier meeting this criterion had 10 vehicles.

The safety of small companies can be problematic. Although there are many exceptions, small companies generally have higher regulatory violation rates in roadside inspections. In chapter four, Small Carrier Violation and Crash Rates, current and past roadside inspection statistics are reviewed and caveats regarding them discussed. The issue of whether or not these higher violation rates are associated with higher crash rates is less clear. The safety and compliance challenges faced by small companies will be examined in this report, with a focus on management activities. As was stated in one of the manager quotations, small company safety management functions are likely to be performed by a single individual who must also undertake other competing and more-pressing functions such as operational management, sales, administration, and financial management. A shortage of management time is often accompanied by a shortage of money. Small company vehicles are likely to be older and less well equipped for safety. Small carriers are less likely to employ sophisticated information systems or have elaborate driver training programs.

On the other hand, small companies have some enviable characteristics from a safety perspective. Their owner/managers have a strong foundation of knowledge and skill; the average survey respondent in this study has had 25 years of industry experience. Their managers often have direct, everyday contact with every driver, vehicle, and customer. Interpersonal relations are stronger in small organizations than in larger ones. Group cohesion contributes to better employee retention, which in turn fosters safe operations. Some small companies find a comfortable market niche and are happy to maintain a steady and relatively low-pressure operation.

This report explores small carrier strengths and weaknesses and identifies potentially effective safety practices for small motor carriers. Few of the issues discussed and practices identified are unique to small carriers, however. By and large, the same practices will be effective regardless of carrier size. Each company's safety outcomes are more reflective of its own safety practices and operating environment than whether it is large or small.

## METHODOLOGY AND MAJOR SOURCES

Project methods included a carrier owner/manager survey (described in chapter two), case study interviews with ten company owners/managers (described in chapter three), and a literature review (methodology described here). Chapter four, Evidence Review, consists primarily of the literature review but also cites pertinent findings from the survey and interviews.

### Literature Review Methodology

Literature review searches were performed using websites, academic databases, books, trade press publications, and articles. The following databases were used to conduct the reviews:

- Transportation Research Information Database (TRID), the largest online bibliographic database of transportation research.
- Business Source Premier, featuring the full text for more than 2,200 journals.
- EconLit, from the American Economic Association's electronic database.
- Emerald Group Publishing, featuring journals and books in business, management, social sciences, and engineering.
- JSTOR, providing access to articles from more than 1,000 journals across the humanities, social sciences, and sciences.
- SciVerse ScienceDirect, from Elsevier publishing, offering access to articles from more than 2,500 peer-reviewed journals, and chapters from more than 11,000 scientific books.

These databases were searched using a variety of topic-related key words and phrases, often in combinations to improve focus. Key words included trucking, safety, small business, small trucking firms, safety management, human resource management, risk management, operations management, occupational safety and health, safety culture, safety climate, crash reduction, driver turnover, driver retention, driver training, and driver supervision.

As a supplement to the academic literature review, a request for information and commentary was sent to members and friends of the TRB Committee on Truck and Bus Safety (ANB70) and the Committee on Trucking Industry Research (AT060). In addition, the FMCSA Analysis Division and the U.S.DOT Volpe National Transportation Systems Center provided statistics on carrier violations and crash rates.

### Major Literature Sources

This report cites scores of studies. Two past studies deserve special mention, as they each collected extensive survey data on motor carrier safety practices, with survey findings disaggregated by carrier size.

*I-95 Corridor Coalition Field Operational Test: Coordinated Safety Management.* Volume I of the report (*Best Practices in Motor Carrier Safety Management,* Stock 2001) addressed best practices by conducting a survey of state motor carrier association members in several northeastern states. The nearly 600 respondents to the survey were said to represent a sample of the best safety performers. The survey addressed hiring criteria, retention, in-house and outside training, top management commitment, safety meetings and awareness programs, safety incentive programs, driver mon-

itoring, and accident review. Trucking company statistics were disaggregated by number of carrier power units (1–9, 10–24, 25–50, 51–100, and >100). Bus company statistics were provided separately, but not disaggregated by company size. The current study definition of small carriers spans several of Stock's smaller carrier size categories. To avoid the presentation of an excessive number of statistics, Stock's statistics for just one category (typically 10 to 24 trucks) are typically cited in this report. Exceptions are made when there are large differences across Stock's smaller categories. Stock also analyzed roadside inspection data from the U.S.DOT MCMIS and compared driver and vehicle violation rates by carrier size.

*Best Highway Safety Practices: A Survey of the Survey of the Safest Motor Carriers About Safety Management Practices.* Under the sponsorship of the FMCSA, the University of Maryland (UM) Supply Chain Management Center surveyed "best safety performers" to identify and define their safety management programs and policies (Corsi and Barnard 2003). The study identified best safety performers through a two-step process, which included review of SafeStat performance data and recommendations from FMCSA state safety directors. A survey completed by 148 safe trucking companies formed the basis for their report. Survey areas included general company information, driver hiring practices, driver training practices, encouraging and reinforcing safe driving behavior, managing and monitoring driver abilities, and managing vehicle maintenance. Many of the questions asked for respondent opinions of the *importance* of various practices, rather than simply asking if the practice was done. Statistics for three carrier size categories were presented: 1–24, 25–94, and >95 power units. Statistics were also disaggregated by cargo commodity types. No bus companies were included in the study.

Key caveats regarding both the I-95 Corridor and UM reports are similar to those for the current report. Most notably, the respondent samples in each should not be construed as representative samples of the motor carrier industry. Rather, they represented "best performers" who were willing to take the time to complete project surveys and share information on their practices. Further, in the UM study there was a concerted effort to limit the survey to best safety performers based on compliance data.

### Past CTBSSP Synthesis Reports

This report extensively cites past CTBSSP reports, especially those addressing core carrier safety management functions. None of these past reports focused primarily on small carrier issues; however, many of them addressed issues of importance to small carriers. More information on the CTBSSP, including free downloads of all past reports can be found at: http://www.trb.org/SynthesisPrograms/Public/CommercialTruckandBusSafetySynthesisProgram.aspx.

## DISCLAIMERS

Five disclaimers are necessary regarding the study methodology and the information presented in this report:

1. Several commercial products and services are mentioned in the course of the interviews and evidence review. No product or service was formally evaluated for this report. Company and brand names provided are illustrative of available products and services. Neither TRB nor this report endorses any company, product, or service.
2. There are regulatory and government policy issues and activities underway regarding various topics in this report, especially those relating to motor carrier enforcement. This report did not systematically address these issues and makes no policy recommendations.
3. Project survey data are based on convenience samples of responding motor carrier managers. Survey data represent the opinions and practices of the respondent samples, not of larger populations such as "all carrier managers." As explained in chapter two, survey samples in projects of this nature contain inherent biases toward respondents who are more active and interested in the topic at hand.
4. Statements reported in the project case studies are those of the interviewees. The opinions expressed in the case study summaries do not necessarily reflect those of the report authors or TRB.
5. Chapter five suggests 27 safety management practices believed by the authors to be generally effective based on all project information sources. Not all of these methods would be useful or applicable to every motor carrier. They are presented as ideas for consideration, not as industry standards.

CHAPTER TWO

# SURVEY METHODS AND RESULTS

The three principal information sources for this study were: (1) the project survey of small carrier owners/managers, (2) in-depth interviews with a subset of survey respondents, and (3) the research literature review. This chapter describes the survey approach, specific methods, and provides principal results. The carrier owner/manager survey asked respondents questions about safety problems they faced, what safety management practices they used, and the effectiveness of these practices. Survey results relating to specific topics are also revisited in chapter four (Evidence Review).

A general caveat regarding most of the survey responses is that they represent subjective responses to subjective questions. A few questions were objective (e.g., questions asking safety managers whether or not they use a particular safety management practice), but most called for subjective judgments by respondents. Another caveat is that the respondent sample should be regarded as a convenience and "judgment" sample of interested, knowledgeable individuals, not as a representative sample of some larger population such as "all small carrier owners/managers." In spite of these caveats, survey findings are revealing because of the comparative information they provide; for example, the perceived relative importance of various safety problems and perceived relative effectiveness of solutions.

Critical to the success of the survey was the support of the following five CMV transport trade associations, two relating to trucking and three to motorcoach transport. These organizations solicited survey participation by their members through e-mail requests containing links to the online survey.

- American Bus Association (ABA)
- Bus Industry Safety Council (BISC)
- National Association of Small Trucking Companies (NASTC)
- Owner–Operators Independent Drivers Association (OOIDA)
- United Motorcoach Association (UMA).

## SURVEY METHOD

### Sampling Approach

The conceptual population for the survey was North American motor carrier (truck and bus) small carrier owners/managers. This population is amorphous and largely inaccessible to survey research. Defining and reaching this conceptual population is problematic because there is no single definition or criterion for "small carrier" and because there is no central respondent list that could serve as a practical basis for probability-based sampling (TRB Committee on Truck and Bus Safety 2010). Therefore, a nonprobability-based convenience sample was used. It might also be characterized as a *judgment* sample, because the participating trade associations were judged by the project team as being excellent sources for small carrier input.

The survey sample space (i.e., potential respondents contacted) consisted primarily of members of the participating trade associations. In comparison to the conceptual population, this sample space is itself biased toward organizations and individuals with more experience, past success, and safety conscientiousness than the overall conceptual population. Those returning the survey (whose responses are presented here) were the *respondents.* Just as the sample space was likely a biased slice of the population, the respondent sample was likely a biased slice of the sample space. In most surveys and almost certainly this one, those responding tended to be more committed and interested in the topic than those not responding. Moreover, they tended to be more educated and verbal than nonrespondents (Walonick 2010). Both sources of bias almost certainly operated in the present survey.

A larger study focusing on the survey *per se* could likely do a better job of capturing the conceptual population. Study resources did not permit a rigorous, probability-based sampling approach. The obtained sample, even if representing a skewed sample of knowledgeable and safety-conscious small carrier respondents, still provided valuable information. It accomplished the following objectives:

- It tapped the views and practices of safety-active small carriers.
- It provided information subjects' *relative* opinions on various safety problems and solutions.
- It provided contacts for follow-up interviews with carrier owners/managers regarding the practices of progressive companies.

### Questionnaire Design and Content

Appendix A presents the project survey form, reformatted for inclusion in this report. The survey form consisted of the sections listed here (with question numbers in parentheses):

- Introduction, including brief statement of the study and survey purpose, and a confidentiality assurance.
- (1–14) Safety problems faced. A series of 14 questions about the relative importance of specific safety problems facing small companies. These employed a 5-point Likert rating scale for importance.
- (15–16) CSA (Compliance, Safety, Accountability) compliance challenges. Two parts:
  - Selection of the two (out of seven) CSA Behavior Analysis and Safety Improvement Categories (BASICs) presenting the biggest safety challenges, and
  - Selection of the two BASIC categories presenting the smallest safety challenges.
- (17–30) Safety management practices. A series of 14 questions on (1) safety management practices they use, and (2) their perceived safety effectiveness using a 5-point Likert scale. These 14 practices should be considered as just a sample of possible small carrier safety practices. Many other worthy safety practices could not be included in the survey owing to survey length considerations.
- (31–32) Important areas of safety management. Ten areas of safety management were listed; respondents
  - Selected up to three (of the nine) they considered most important; that is, having the greatest effect on safety outcomes.
  - Selected up to three they considered least important; that is, having the *least* effect on safety outcomes.
- (33) Other comments regarding safety management in small motor carriers. Open response box.
- (34–35) Carrier size. Two multiple choice items:
  - Owner/manager role in carriers of four "functional" size ranges (see Appendix A, Question 34).
  - Number of nonnondriver employees.
- (36–37) Information about respondent experience:
  - Years of experience as company owner/manager.
  - Total years of experience in commercial truck/bus operations.
- (38–39) Additional information about the company:
  - Number of power units (open response box).
  - Principal operation type (eight choices).
- (40) A space to optionally provide an e-mail address to which to send the project report pdf.
- (41) A space to optionally volunteer for a paid interview on innovative carrier practices for the project case studies.

#### Survey Distribution and Administration

The survey was administered using TRB's online survey service. The project team constructed the questionnaire, transcribing the questions provided in Appendix A to the automated format. This included a web link to access the survey and a link within the survey for accessing a copy (pdf) of the questionnaire that could be saved and/or printed by respondents. Researchers also prepared draft e-mail text for use by the participating trade associations in soliciting their members. The associations were asked to target carriers in the 3 to 75 power unit range, if possible; this range was considered inclusive of responding carriers who would meet the principal criterion (defined here) for inclusion in reported results. Separate files were used for each trade association so its member statistical results could be seen separately and provided to association officials for their use. In most cases, the initial request e-mail was followed a few weeks later by a second, follow-up request.

#### Data Analysis and Interpretation

Survey tabulations for respondents from each trade association (and the fifth "general" file) were provided automatically. These tabulations were entered onto an Excel spreadsheet and summed across the five sources. The following sections describe specific aspects of data analysis and interpretation.

##### *Principal Criterion for Inclusion of Data*

A specific criterion was applied to most survey questions to limit the reported results to the principal focus of the study; that is, those carriers large enough to have a "non-driver" manager but too small to have multiple managers. Because most such managers retain their Commercial Drivers Licenses (CDLs) and may occasionally drive, a "nonnon-driver" manager was defined as one who drives less than 50% of the time. Question 34 of the survey was the basis for this filtering. Unless noted otherwise for a particular question, all reported survey results in this report are for respondents who answered "c" on this question:

(34) Which best describes you and your company?
  (a) Solo owner–operator (i.e., you are the only driver).
  (b) Driver (drives 50% or more of the time), but also operates other vehicles and employs other drivers.
  (c) Company owner/manager. Drives less than 50% of the time. Performs most management and supervision tasks, including safety and compliance.
  (d) Owner/manager of company large enough to have multiple managers, including a designated manager of safety and/or compliance.

A total of 262 respondents (187 truck, 75 bus) completed the online survey, but only 112 of these (79 truck, 33 bus) answered "c" on this question. The statistics reported and discussed elsewhere in this report are based on the responses of these 112 companies.

##### *Nonreporting of Response Percentages*

In accordance with CTBSSP policy, the survey results in this chapter and cited elsewhere in this report do not include results percentages. Instead, raw numbers are cited (e.g., "42 of 51 respondents . . ."). This practice reduces the likelihood

that survey results will be misinterpreted or incorrectly cited as representing larger respondent populations. Readers may generate their own percentages; however, they should not be stated as being representative of larger groups.

*Likert Scale Numeric Means*

Likert scales are rating scales, sometimes with numbered choices (e.g., ranges such as 0–4, 1–5, or 1–7). Likert scales usually have word descriptors for each choice, or "anchor" choices at the ends and perhaps the middle. Two different Likert scales were used in project surveys:

- A 5-point scale on the importance of various safety problems. Choices ranged from "not important" to "extremely important."
- A 5-point scale rating the effectiveness of carrier safety management practices. Choices ranged from "highly ineffective" to "highly effective."

Likert scale choices in the current survey were not numbered on the form seen by respondents; however, choices were subsequently assigned numbers (0, 1, 2, 3, or 4) for analysis. Results are provided in the form of respondent counts for each choice along with the weighted arithmetic mean of all choices. TRB's online survey service also provided these statistics automatically in survey reports.

*Caution on Interpretation of Results*

As emphasized earlier, the obtained survey sample should be considered a convenience or judgment sample that is not representative of any larger respondent population. Further, one should consider the nature of the questions when interpreting results. There were three general types of survey questions: (1) questions about respondent *opinions,* (2) questions about *specific carrier practices,* and (3) questions about *respondents themselves* and their *companies.* Opinion questions were subjective and called for subjective, judgmental responses, mostly in the form of Likert scale ratings or forced choices. These responses should not be misinterpreted as objective facts. Objective questions included those on specific carrier practices used (yes/no) and those about carrier and respondent characteristics. The nonrepresentativeness caveat applies to all survey questions.

### Follow-Up Structured Interviews

The last question of the survey form asked respondents if they would be interested in participating in a paid follow-up interview to discuss innovative fleet practices. The purpose of the interviews was to gather information and opinions for project case study write-ups (see chapter three). If respondents did volunteer, and their survey answers suggested they were actively engaged in safety management (e.g., had a relatively large number of "yes" responses under carrier practices and/or offered additional written comments), they could be contacted to schedule an interview. Altogether, 15 respondents were contacted by e-mail and/or by phone. The 15 initial contacts resulted in ten interviews. These ten provided substantial information on innovative small carrier safety practices, which is contained in chapter three.

## SURVEY RESULTS

Unless otherwise stated, all of the results are for all truck and bus respondents answering "c" on Question 34 regarding carrier functional size. Results are disaggregated for truck and bus respondents for those questions relating to areas in which truck and bus operations are markedly different.

### Importance of Various Safety Management Problems

Questions 1–14 asked about the relative importance of specific safety problems facing small companies. These employed a 5-point Likert rating scale for importance. The specific instructions were as follows:

> **Importance of Various Safety Management Problems**
>
> Items 1–14 present various safety management problems you may face. Rate the importance of each problem. Extremely important items are those with the strongest relation to crash risk, and requiring your greatest attention. If you have no opinion, leave it blank and move on to the next question.

The five Likert scale choices were as follows. The numerical values for each choice were *not* shown on the survey form, but were used subsequently to tabulate results.

- Not Important [0]
- Somewhat Important [1]
- Important [2]
- Very Important [3]
- Extremely Important [4].

Table 1 provides the number of responses for each choice, the total number of responses (*N*), and the weighted arithmetic average or mean of responses (Avg.). Averages are rounded to the nearest tenth. Note that truck and bus respondents are disaggregated for Question 10 ("Delays associated with loading and unloading . . .") and that the question was worded somewhat differently for the two groups.

Note first that all ratings were heavily skewed toward higher importance ratings and that 14 problems received overall average ratings of greater than 2.0 on the 4-point scale. Thus, all the problems were considered to be "important or greater." Relative ratings provide insights on those problems considered most and least important within this group. The highest-rated safety problems included (6) recruiting and selecting good drivers, (2) at-risk driving behaviors, and (7) assessing driver on-road safety. Problems rated *relatively* unimportant compared with others on the list included

TABLE 1
LIKERT SCALE RATINGS FOR IMPORTANCE OF VARIOUS SAFETY MANAGEMENT PROBLEMS

| Likert Rating or Statistic: / Safety Problem: | 0 | 1 | 2 | 3 | 4 | *N* | Avg. |
|---|---|---|---|---|---|---|---|
| (1) Lack of basic driving skills among your drivers | 11 | 10 | 14 | 20 | 54 | 109 | 2.88 |
| (2) At-risk driving behaviors (e.g., speeding, tailgating) | 3 | 9 | 16 | 28 | 56 | 112 | 3.12 |
| (3) Driver fatigue/drowsiness | 8 | 12 | 10 | 29 | 50 | 109 | 2.93 |
| (4) Driver health, wellness, and nutrition problems | 5 | 16 | 35 | 38 | 18 | 112 | 2.43 |
| (5) Driver personal, family, and financial problems | 7 | 19 | 38 | 33 | 12 | 109 | 2.22 |
| (6) Recruiting and selecting good drivers | 0 | 4 | 15 | 34 | 58 | 111 | 3.32 |
| (7) Assessing driver on-road safety (i.e., knowing how safe your drivers are) | 2 | 5 | 20 | 46 | 39 | 112 | 3.03 |
| (8) Correctly rewarding good driver behaviors and disciplining bad behaviors | 1 | 7 | 24 | 50 | 29 | 111 | 2.89 |
| (9) Driver turnover resulting in an unstable workforce | 6 | 12 | 23 | 36 | 31 | 108 | 2.69 |
| (10) Delays associated with loading and unloading cargo [truck respondents only] | 4 | 4 | 17 | 28 | 26 | 79 | 2.86 |
| (10) Delays associated with loading and unloading passengers and cargo [bus respondents only] | 8 | 10 | 5 | 7 | 3 | 33 | 1.61 |
| (11) Non-driving injuries and other accidents (e.g., slips and falls, cargo-related) | 5 | 24 | 27 | 33 | 20 | 109 | 2.36 |
| (12) Not enough management time to adequately address all safety problems and issues | 7 | 19 | 29 | 32 | 22 | 109 | 2.39 |
| (13) Lack of training materials (or easy access to them) for drivers | 14 | 23 | 25 | 27 | 20 | 109 | 2.15 |
| (14) Lack of training materials (or easy access to them) for yourself as a manager | 14 | 17 | 25 | 36 | 16 | 108 | 2.21 |
| Grand mean: | | | | | | | 2.65 |

(13) lack of training materials for drivers, (14) lack of training materials for managers, and (5) driver personal/family/financial problems. Figure 1 shows the same statistics graphically and in descending order of mean importance rating.

### CSA (Compliance, Safety, Accountability) Compliance Challenges

Questions 15 and 16 presented the seven CSA Behavior Analysis and Safety Improvement Categories (BASICs). Respondents were asked to select the two areas representing the biggest and smallest safety challenges, respectively. The specific questions were as follows:

15. In the CSA, there are seven Behavior Analysis and Safety Improvement Categories (BASICs). Which two BASIC areas are the *biggest compliance challenges* for your company. In other words, the areas where compliance is most difficult? If you are not sure, leave the answer blank.

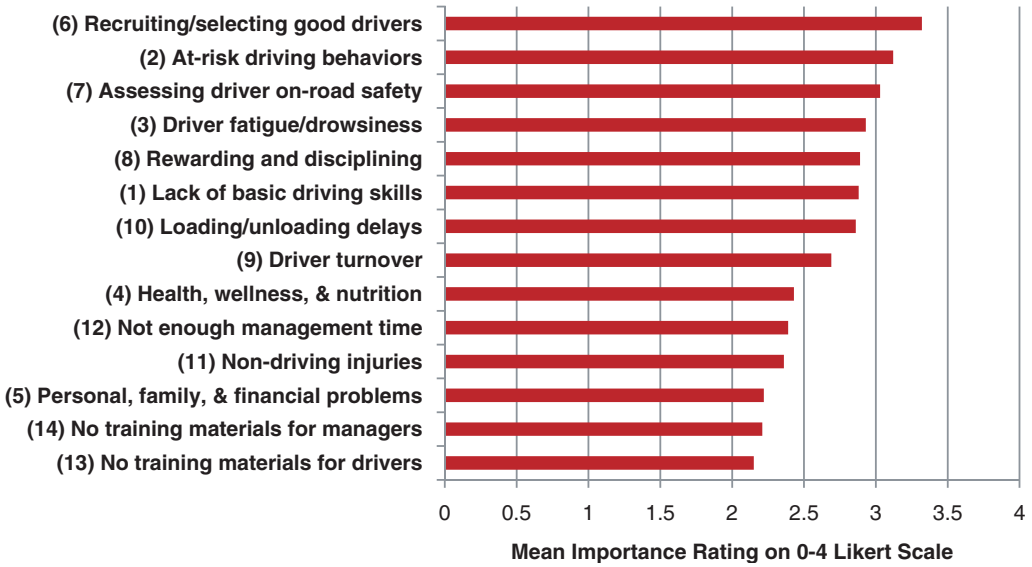


FIGURE 1 Mean importance ratings for 14 safety problems.

TABLE 2
BIGGEST CSA COMPLIANCE CHALLENGES

| Behavior Analysis and Safety Improvement Categories (BASICs) Compliance Challenges | Trucks | Buses |
|---|---|---|
| a) Unsafe Driving—speeding, reckless driving, improper lane change, inattention | 29 | 13 |
| b) Fatigued Driving—HOS, logbook violations | 40 | 14 |
| c) Driver Fitness—missing CDLs, medical qualifications | 7 | 5 |
| d) Alcohol, Drugs—impairment by alcohol, drugs, or medications | 3 | 1 |
| e) Vehicle Maintenance—failure to make repairs; adjust brakes, etc. | 25 | 6 |
| f) Cargo Securement—shifting, spilled, dropped cargo, size-wieght violations, unsafe hazmat handling | 12 | 1 |
| g) Crash History—frequency, severity of DOT-defined crashes | 8 | 1 |
| Total Responses: | 124 | 41 |

16. Which two BASIC areas are the *smallest* compliance challenges for your company. In other words, the areas where compliance is easiest?

Table 2 presents the results for Question 15 disaggregated by truck and bus (passenger carrier) operations. Results for this question are disaggregated principally because choice "f" (cargo securement) does not typically apply to bus operations. Also, roadside inspection practices are different for trucks and buses. Buses are typically inspected at their terminal locations (e.g., destinations) rather than inspected en route.

For both trucks and buses, the top three items were (b) Fatigued Driving [HOS (hours of service)], (a) Unsafe Driving, and (e) Vehicle Maintenance. For trucks, those judged least challenging were (d) Alcohol/Drugs, (c) Driver Fitness, and (g) Crash History. For buses, they were (d) Alcohol/Drugs, (f) Cargo Securement, and (g) Crash History. Figure 2 is a histogram of the Question 15 "biggest" responses, normalized based on the total number of responses.

Table 3 presents Question 16 (smallest CSA compliance challenges) responses, again disaggregated by vehicle type (trucks versus buses). As expected, these results mirror those shown earlier. For trucks and buses combined, the correlation between "biggest" to "smallest" responses across the seven items was –0.85.

### Use and Effectiveness of Operational Practices

Questions 17–30 presented 14 carrier practices and first asked respondents to state whether or not they regularly used the practice (yes or no). Respondents answering "yes" on a question were then presented with a question asking them to rate the effectiveness of the practice on a 5-point Likert scale. The initial instructions were as follows:

**Which Operational Practices Do You Regularly Use?**

For each of the operational practices below, please indicate *yes* or *no* whether your company uses the practice. If **yes**, rate its overall effectiveness using the scale provided.

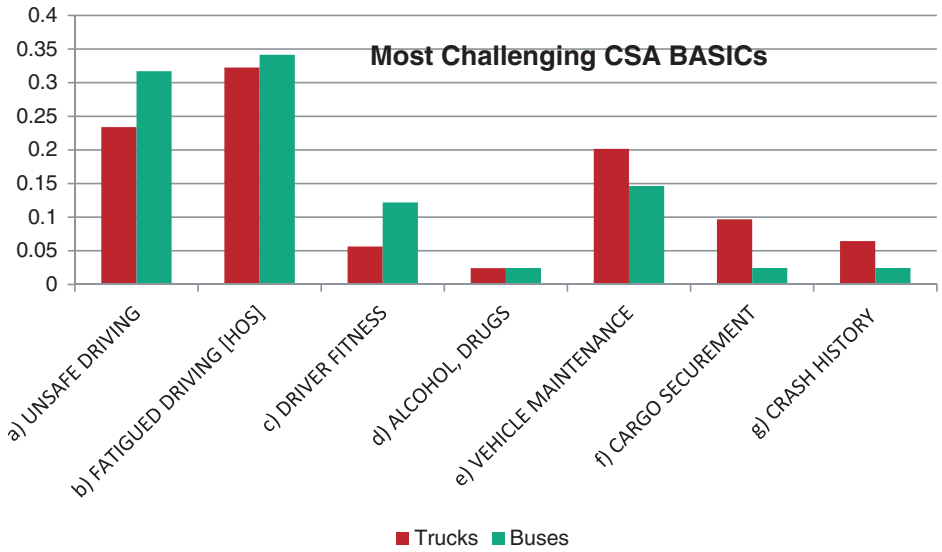


FIGURE 2 Proportion of respondent votes for biggest CSA BASIC compliance challenges for truck and bus respondents.

TABLE 3
SMALLEST CSA COMPLIANCE CHALLENGES

| Behavior Analysis and Safety Improvement Categories (BASICs) Compliance Challenges | Trucks | Buses |
|---|---|---|
| a) Unsafe Driving—speeding, reckless driving, improper lane change, inattention | 15 | 4 |
| b) Fatigued Driving—HOS, logbook violations | 12 | 6 |
| c) Driver Fitness—missing CDLs, medical qualifications | 23 | 12 |
| d) Alcohol, Drugs—impairment by alcohol, drugs, or medications | 45 | 11 |
| e) Vehicle Maintenance—failure to make repairs; adjust brakes, etc. | 21 | 6 |
| f) Cargo Securement—shifting, spilled, dropped cargo, size-wieght violations, unsafe hazmat handling | 24 | 11 |
| g) Crash History—frequency, severity of DOT-defined crashes | 20 | 12 |
| Total Responses: | 160 | 62 |

The five Likert scale choices were as follows. The numerical values for each choice were *not* shown on the survey form, but were used to tabulate results.

- Highly Ineffective [0]
- Ineffective [1]
- Not Sure/Neutral [2]
- Effective [3]
- Highly Effective [4]

Table 4 provides the number of respondents reporting using each practice. Table 5 shows the effectiveness ratings given by users of the practice. The effectiveness responses were fewer because nonusers were not presented with the rating questions. Statistics provided include the number for each Likert scale choice, the total number of responses (*N*), and the weighted arithmetic average or mean of responses (Avg.). Averages are rounded to the nearest tenth. Responses shown for Question 27 (relating to detention charges for loading and unloading delays) are limited to truck respondents.

Respondents used an average of 8 of the 14 practices listed. The most frequently used were (26) PM (preventive maintenance) schedules, (28) reimbursing tolls, (29) tracking overall company safety statistics, and (17) conducting road and range driving tests with driver applicants. By far the least frequent practice was (25) purchasing advanced vehicle safety systems. This was followed by (23) use of electronic onboard recorders (EOBRs), and (18) use of driver applicant questionnaire on attitudes, personality, or driving behaviors.

All 14 of the practices received generally high ratings among users. Safety management practices used by a majority

TABLE 4
RESPONDENT USE OF SAFETY MANAGEMENT PRACTICE

| Rating or Statistic: / Safety Management Practice: | Yes | No | *N* |
|---|---|---|---|
| (17) Conduct road and range driving tests with all driver applicants | 92 | 18 | 110 |
| (18) Have driver applicants complete questionnaire on attitudes, personality, or driving behaviors | 20 | 92 | 112 |
| (19) Conduct regularly scheduled safety meetings with drivers | 91 | 20 | 111 |
| (20) Give drivers bonuses or other rewards for safe driving | 52 | 59 | 111 |
| (21) Use online web-based training programs for drivers, other employees, or yourself | 35 | 76 | 111 |
| (22) Use training media in-house (e.g., DVDs, PowerPoint presentations) | 65 | 45 | 110 |
| (23) Use electronic onboard recorders (EOBRs) | 16 | 94 | 110 |
| (24) Monitor individual driver fuel economy | 80 | 32 | 112 |
| (25) Purchase advanced vehicle safety systems (forward collision warning, lane departure warning, electronic stability control, onboard computers to monitor driving, etc.) | 4 | 107 | 111 |
| (26) Maintain preventive maintenance schedule and record for each vehicle | 109 | 3 | 112 |
| (27) Charge extra fees to customers for excessive loading/unloading delays [truck respondents only] | 62 | 17 | 79 |
| (28) Reimburse toll charges to drivers and/or provide EZ Pass" transponders | 98 | 13 | 111 |
| (29) Track overall company safety statistics (e.g., crash and violation rates, financial losses from crashes) | 97 | 13 | 110 |
| (30) Participate in formal or informal meetings with your peers; e.g., truck or bus association meetings or other gatherings | 73 | 36 | 109 |

TABLE 5
USER LIKERT SCALE RATINGS OF EFFECTIVENESS OF SAFETY MANAGEMENT PRACTICES

| Rating or Statistic: / Safety Management Practice: | 0 | 1 | 2 | 3 | 4 | *N* | Avg. |
|---|---|---|---|---|---|---|---|
| (17) Conduct road and range driving tests with all driver applicants | 3 | 1 | 13 | 48 | 26 | 91 | 3.02 |
| (18) Have driver applicants complete questionnaire on attitudes, personality, or driving behaviors | 1 | 0 | 3 | 11 | 5 | 20 | 2.95 |
| (19) Conduct regularly scheduled safety meetings with drivers | 1 | 1 | 27 | 46 | 15 | 90 | 2.81 |
| (20) Give drivers bonuses or other rewards for safe driving | 1 | 3 | 11 | 28 | 8 | 51 | 2.76 |
| (21) Use online web-based training programs for drivers, other employees, or yourself | 1 | 2 | 15 | 15 | 2 | 35 | 2.43 |
| (22) Use training media in-house (e.g., DVDs, PowerPoint presentations) | 2 | 1 | 22 | 35 | 5 | 65 | 2.62 |
| (23) Use electronic onboard recorders (EOBRs) | 0 | 0 | 3 | 4 | 9 | 16 | 3.38 |
| (24) Monitor individual driver fuel economy | 3 | 0 | 22 | 44 | 11 | 80 | 2.75 |
| (25) Purchase advanced vehicle safety systems (forward collision warning, lane departure warning, electronic stability control, onboard computers to monitor driving, etc.) | 0 | 0 | 0 | 2 | 2 | 4 | 3.50 |
| (26) Maintain preventive maintenance schedule and record for each vehicle | 3 | 1 | 10 | 54 | 41 | 109 | 3.18 |
| (27) Charge extra fees to customers for excessive loading/unloading delays [truck respondents only] | 2 | 10 | 19 | 20 | 11 | 62 | 2.45 |
| (28) Reimburse toll charges to drivers and/or provide EZ Pass transponders | 2 | 5 | 23 | 43 | 24 | 97 | 2.85 |
| (29) Track overall company safety statistics (e.g., crash and violation rates, financial losses from crashes) | 1 | 3 | 28 | 55 | 10 | 97 | 2.72 |
| (30) Participate in formal or informal meetings with your peers; e.g., truck or bus association meetings or other gatherings | 1 | 3 | 13 | 41 | 13 | 71 | 2.87 |
| Grand Mean (unweighted): | | | | | | | 2.89 |

of carrier respondents *and* receiving high favorable ratings included (26) maintaining PM schedules, (17) conducting road and range tests for driver applicants, and (30) participating in peer meetings. Ironically, perhaps, the three least-used practices all received high average effectiveness ratings from those who used them. These were (25) purchasing advanced vehicle safety systems, (23) use of EOBRs, and (18) use of driver applicant questionnaires on attitudes, personality, or driving behaviors. Across the 14 practices, there was a negative correlation of –0.31 between the percent of respondents using a practice and the average effectiveness value assigned to that practice by users.

#### Important Areas of Safety Management

Questions 31 and 32 listed ten general areas of safety management. In Question 31, respondents were asked to select up to three items they considered most important; that is, having the *greatest effect* on carrier safety outcomes (i.e., crashes, incidents, and violations). In Question 32, they were asked to select up to three items they considered least important; that is, having the *least* effect on carrier safety outcomes.

Table 6 provides the results for Question 31, disaggregated by trucks versus buses. For both trucks and buses, the two areas judged most important were (a) driver selection and hiring, and (i) vehicle PM. Other areas judged as relatively more important included (b) driver training and communications, (e) scheduling and dispatching, and (c) driver evaluation. Note the very low priority places on (h) vehicle safety equipment. A small caveat regarding these results is that all subjects were presented with these items in the same order; therefore, any possible order effects could not be controlled. Figure 3 shows the same findings graphically, with the truck and bus responses both expressed as proportions to permit direct comparisons.

Table 7 provides the results for Question 32, disaggregated by trucks versus buses. As one would expect, the

TABLE 6
MOST IMPORTANT SAFETY MANAGEMENT AREAS

| Areas of Safety Management | Trucks | Buses |
|---|---|---|
| (a) Driver selection and hiring | 62 | 27 |
| (b) Driver training, orientation, and communications (e.g., safety meetings) | 29 | 16 |
| (c) Driver evaluation (i.e., violation and incident tracking, ride-alongs, covert observations of driving, onboard computer monitoring) | 23 | 9 |
| (d) Driver performance consequences; i.e., rewards and discipline | 11 | 2 |
| (e) Driver scheduling and dispatching practices | 23 | 16 |
| (f) Trip planning, routing, and navigation | 12 | 7 |
| (g) Loading, cargo securement, unloading, and dock/yard practices | 10 | 0 |
| (h) Vehicle safety equipment (e.g., technologies such as collision avoidance systems) | 1 | 1 |
| (i) Vehicle preventive maintenance | 55 | 21 |
| (j) Monitoring carrier CSA scores and other safety performance measures | 11 | 3 |
| Total Responses: | 237 | 102 |


FIGURE 3 Proportion of "most important" votes for ten areas of safety management for truck and bus respondents.

TABLE 7
LEAST IMPORTANT SAFETY MANAGEMENT AREAS

| Areas of Safety Management | Trucks | Buses |
|---|---|---|
| (a) Driver selection and hiring | 3 | 0 |
| (b) Driver training, orientation, and communications (e.g., safety meetings) | 8 | 2 |
| (c) Driver evaluation (i.e., violation and incident tracking, ride-alongs, covert observations of driving, onboard computer monitoring) | 3 | 2 |
| (d) Driver performance consequences; i.e., rewards and discipline | 18 | 9 |
| (e) Driver scheduling and dispatching practices | 16 | 3 |
| (f) Trip planning, routing, and navigation | 41 | 7 |
| (g) Loading, cargo securement, unloading, and dock/yard practices | 33 | 24 |
| (h) Vehicle safety equipment (e.g., technologies such as collision avoidance systems) | 32 | 14 |
| (i) Vehicle preventive maintenance | 2 | 1 |
| (j) Monitoring carrier CSA scores and other safety performance measures | 34 | 17 |
| Total Responses: | 190 | 79 |

numbers of "most important" and "least important" votes for each area of safety management were generally inversely related. For trucks and buses combined, the correlation between Question 31 and Question 32 responses across the ten items was –0.81.

#### Written Comments

Question 33 asked respondents if they had, "Other comments regarding safety management in small carriers." The comments received are provided here and are presented in four general categories: driver management, vehicles and cargo, enforcement and compliance, and general management. Some comments have been edited for clarity and context.

*Driver Management*

- It is all about having/hiring the right people who have the right attitude. Then monitoring their progress helps keep them on track.
- We only hire experienced competent drivers. They know their job.
- The most important safety feature in a truck is the driver. That is why we are very selective in our recruiting and try to be at the top of the pay scale to attract the highest quality driver.
- Know who you are hiring, and do not make exceptions to hiring good drivers. It will harm you down the road.
- Our biggest company problem is finding drivers.
- If you hire correctly, train effectively (not only at hire, but throughout employment), use onboard monitoring, and set your trucks at 65, you will do fine in all departments. This is provided you know what to charge to stay in business. Safety does pay.
- Driver training and CDL requirements for motorcoach drivers are very low in the United States compared with other developed countries (Europe).
- Do not get so big that the owner does not know every person on payroll, and make it their business to personally check out every driver every day! Big companies are a big problem when they look only for income and not their relationship with those who provided it.
- We do not over-schedule drivers and they are all owner–operators.

*Vehicles and Cargo*

- Vehicle safety equipment is more often than not too costly for small carriers to obtain in today's economy.
- The continual adding of expensive [equipment and] cost to new motorcoaches is pricing a new coach at an impossible level for many small companies. Thus, older vehicles will be used much longer.
- We would love to try EOBRs but do not have the budget. Funding these safety advances will be critical to smaller operators.
- Pre- and post-trip inspections [are very important].
- Most owner–operators and small fleet operators do a good job of maintenance and safety but are lacking in the back-up aspects such as paperwork. I know owner operators that do their own maintenance work but do not keep very good records.

*Enforcement and Compliance*

- The problem I see is for small carriers trying to keep up with all the changes and regulations that are taking place.
- DOT makes judgment calls and cites violations about a loose strap or fuel cap (with no spillage). I have heard of DOT writing a driver up for having a Gatorade Bottle sitting on the floor board of his truck!
- It is as if the new system [CSA] is geared toward killing the small guys. The big guys are winning and small guys are fighting a losing battle, but we are fighting . . .
- [Bus respondent] The biggest threat to safety is rogue operators. Companies such as ours, who are checked regularly by inspectors, are not the highest safety threat. It is the rogue operators who do their very best to avoid inspectors [who] are the ones inspectors need to be looking for. We see their shoddy equipment and illegal operations on a regular basis. Why cannot enforcement officials see it?
- DOT and DOD [Department of Defense] need to stop allowing people and companies to operate unless they are American citizens, speak English well, and have been inspected and pass all inspections before they ever roll a tire on my highways. DOT and other federals create most of all the problems we have.
- We haul big bales of recycled cardboard. We get violations for having a small piece of cardboard falling or blowing off the truck but we have never lost a load or had a bale fall off the trailer.

*General Management*

- We are a newly established carrier that follows safety practices in our company very closely.
- Many small operators do not have the financial resources to have a separate safety department/individual. So safety ends up with someone else who is already "wearing another hat(s)." As a result, small operators have to make decisions as to how their limited resources

are allocated to maintenance, driver training, safety programs, etc.
- We utilize an outside consulting firm for our safety management. This has proven very cost-effective, allowing us to keep a higher level of safety focus than management time would normally allow.
- Safety is an attitude, more than anything else. If the drivers know that I want them personally safe, as well as the public, they know I am concerned all around. We have a saying that everyone hears at least once per month, "We hurt no one, and we don't hurt ourselves." If you focus on one or the other, the other should take care of itself. Everything in management is aimed at achieving our stated goal.
- In many companies, the owner wears many hats. Safety is only one and deciding where to expend your time and resources is a struggle every small company has.

#### Information About Respondents and Their Fleets

Safety managers were also asked six questions (Questions 34–39) about their company, their job, and their professional experience. As discussed earlier in this chapter, Data Analysis and Interpretation, Question 34 was the critical question used to identify respondents meeting the criterion for inclusion in the survey tabulations. This question asked respondents to select one of four choices that best described their job and the "functional" size of their company. Table 8 provides a breakdown of responses. This study focuses on those respondents answering "c." These are carriers large enough to have a nondriver manager (i.e., one driving less than 50% of the time) but too small to have multiple managers. Thus, unless otherwise stated, response statistics for all other survey questions in this report are limited to those respondents.

Question 35 asked respondents how many nondriver employees they had (not including themselves). Table 9 presents the response breakdowns for respondents of interest (i.e., those answering "c" in Question 34).

Question 36 asked their years of experience as a carrier owner/manager, and Question 37 asked their total years of experience in commercial truck/bus operations. Table 10 provides summary statistics of their answers.

Altogether, the 111 respondents claimed 1,972 years experience as owners/managers and 2,747 years total experience in CMV transport. As a group, they are highly experienced.

TABLE 8
RESPONDENT COMPANY "FUNCTIONAL" SIZE

| (34) Which best describes you and your company? | No. Respondents |
|---|---|
| (a) Solo owner–operator (i.e., you are the only driver) | 30 |
| (b) Driver (drives 50% or more of the time), but also operates other vehicles and employs other drivers | 47 |
| (c) Company owner/manager. Drives less than 50% of the time. Performs most management and supervision tasks, including safety and compliance | 112 |
| (d) Owner/manager of company large enough to have multiple managers, including a designated manager of safety and/or compliance | 73 |
| Total: | 262 |

TABLE 9
CARRIER NUMBER OF NONDRIVER EMPLOYEES (EXCLUDING OWNER/MANAGER)

| How many nondriver employees? | 0 | 1 | 2 | 3 | 4 or More | Total *N* |
|---|---|---|---|---|---|---|
| Number of respondents: | 22 | 29 | 17 | 11 | 32 | 111 |

TABLE 10
SUMMARY STATISTICS ON PROFESSIONAL EXPERIENCE OF SM RESPONDENTS

| Statistic: / Question: | Range | Median | Mean | SD |
|---|---|---|---|---|
| (36) Number of years experience as carrier owner/manager | 1 to 50 | 16 | 17.8 | 11.6 |
| (37) Total years experience in commercial truck/bus operations | 2 to 56 | 25 | 24.8 | 10.4 |

SD = Standard Deviation.

TABLE 11
RESPONDENT FLEET SIZE

| Statistic: / Question: | Range | Median | Mean | SD |
|---|---|---|---|---|
| Number of carrier power units for respondents meeting study criterion (i.e., Question 34 = "c"). | 1 to 50 | 7 | 10.1 | 10.4 |

SD = Standard Deviation.

TABLE 12
SM RESPONDENTS' FLEET OPERATION TYPES

| Operation Type | No. Respondents |
|---|---|
| (a) Truck for hire: long haul/truckload, national | 34 |
| (b) Truck for hire: long haul/truckload, regional | 28 |
| (c) Truck for hire: local/short haul (most trips < 100 miles) | 8 |
| (d) Truck private industry: long haul, national or regional | 3 |
| (e) Truck private industry: local/short haul (< 100 miles) | 4 |
| (f) Passenger carrier: scheduled service | 0 |
| (g) Passenger carrier: charter | 30 |
| (h) "Other" | 2 |
| Total (*N*): | 109 |

Question 38 asked respondents to state the number of power units (i.e., tractors, trucks, or buses) currently in their fleets. Table 11 provides summary statistics of their answers for these respondents.

Question 39 asked respondents to select the truck or bus operation type that best characterized their fleet. The number of responses in each category is listed in Table 12. Less-than-truckload (LTL) was not provided as an option because these carriers are rarely small and were not targeted in the survey solicitations.

Specific survey findings are noted in chapter four, Evidence Review, as part of the discussion of various safety management topics. Chapter five, Conclusions (specifically, Study Survey Finding), recaps major survey findings.

CHAPTER THREE

# CASE STUDIES

This chapter presents findings from ten case study interviews with carrier owners/managers. The case studies are based on phone interviews, which followed the completion of the survey for each respondent. The final survey question asked respondents if they would be interested in participating in a paid follow-up interview to discuss innovative fleet practices. The question included the assurance, "Responses will be confidential; no interviewees or carriers will be identified unless desired." Interviewees were selected based on their willingness to participate and on indications in the survey that they were actively engaged in carrier safety. The project team contacted 15 respondents by means of e-mail and/or telephone; ten responded to the request and agreed to participate. The phone interviews lasted approximately 40 minutes each and followed a structured but flexible sequence of questions. Interviewees were sent a small payment ($50.00) in appreciation for their participation.

As seen in the individual interview summaries, the interviews addressed the following general topics:

- Carrier description
- Interviewee background and job tasks
- Carrier safety problems/challenges
- CSA challenges
- Important areas of safety management
- Effective safety management practices
- Desired or planned safety enhancements
- Additional comments.

The responses shown in the right column of each case study summary include some answers transcribed from the survey questionnaire in addition to comments from the phone interview. When specific survey answers are cited, the question number or answer choice letter is provided in parentheses next to the answer.

Companies are identified here only as "Carrier A," "Carrier B." No interviewee names or company contact information is provided.

All of the interviewees projected themselves as conscientious individuals and well-intended managers of their companies' safety operations. Many good safety insights and examples of effective management practices are provided in the case studies. Nevertheless, project resources did not permit formal evaluation of any carrier or its practices. No carrier or public records on safety or compliance were examined. Doing so would have required a far greater contract effort and would likely have sharply reduced participation. Practices described should be taken as suggestions for consideration by readers, not necessarily as scientifically proven methods. Industry readers may judge for themselves the applicability of methods and ideas presented to their operations.

As with the project survey, the structure interviews and case study write-ups are intended to capture both objective information (e.g., carrier characteristics and practices used) and subjective information (e.g., opinions on safety risks, effective practices, and outside factors affecting their companies). Some of the interview questions addressed controversial topics, most notably government regulations and enforcement practices (CSA in particular). Varied views on these topics were stated and are conveyed here to fully and accurately capture interviewee opinion. These opinions may be paraphrased in the write-ups or provided as direct quotations.

Case study examples and interview comments will be revisited in chapter four, Evidence Review, in the context of specific safety management topics (e.g., driver hiring and training). In addition, insights from the case studies inform the report conclusions presented in chapter five.

## TRUCKING COMPANIES

Eight trucking company owners/managers were interviewed. Their case studies are presented here in ascending order of carrier size (number of power units). Six of the eight companies were in the principal targeted carrier functional size range. This was defined as large enough to have a manager who drives less than 50% of the time, but too small to have multiple managers including a designated manager of safety and/or compliance. The exceptions are Carrier A, that has three trucks and husband–wife co-managers who also drive full-time, and Carrier H, which has in recent years grown large enough (26 trucks) to have both a general manager and a safety director. These two carriers were included to provide the perspectives of companies just smaller than, and just larger than, the principal carrier size of interest.

**Carrier A, International TL (Truckload) Long-Haul**

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| **Carrier A Description** | Carrier A, based in Canada, has just three trucks, although it will soon add a fourth. The company is owned and managed by a husband and wife who both drive full-time while jointly managing the business. They employ a third driver and soon plan to bring their adult son into the company as a driver. Carrier A primarily hauls rolls of paper in dry vans, serving four paper producers. Their trips take them down the East Coast, to the Midwest, to Texas, and sometimes farther west. Most trips are 4 to 5 days, although their third driver is usually out for 8 to 10 days and home for 4 days. Carrier A works under contract to a larger TL carrier that buys its insurance and books its loads. |
| **Interviewee and Job Description** | The interviewee had been raised in a trucking family and spent 18 years of her career doing administration and accounting for a trucking firm. Seven years ago she and her husband started their own company, and she became a driver–manager. Both drive full-time while splitting company management and other tasks between them. She does the administrative, tax, and other office work while he maintains the vehicles. |
| **Biggest Safety Problems and Challenges** | On the survey form, the interviewee rated almost all of the 14 safety challenges presented as being extremely important. In comments, she made it clear that vehicle maintenance was the dominant ongoing safety management concern. She was less concerned about driver safety issues because she maintained a high level of confidence in her husband, herself, and their third driver. They have 74 combined years of crash-free and claim-free driving. She did worry about the "stupid things [other motorists] do that create a hazard and put myself and other motorists in danger." She also worries about random equipment failures. She had had a scare when a steering tire blew out and her truck ended up in the median. "Anything can happen out there," she said. |
| **CSA Challenges and Comments** | In survey Question 15, Fatigued Driving/HOS (b) and Cargo Securement (f) were rated as the most challenging CSA BASICs. Driver Fitness (c) and Alcohol/Drugs (d) were the least challenging. CSA and roadside inspections exert strong pressure on Carrier A, and the interviewee believed that the system was often unfair. For example, she had been cited for a vehicle violation on a brand new trailer and regarded the citation as bogus. Although it is possible to appeal, the process is too onerous and time-consuming. Some equipment failures such as burned out lights occur randomly and are not always detectable while driving. Carriers can minimize these violations, but they cannot eliminate them.<br><br>Sealed loads present an unfair noncompliance risk for drivers, especially those crossing the border. A load sealed by a shipper cannot be opened for inspection by the driver; if the seal is broken, the receiver will refuse the load. However, it may be opened by inspectors, especially at the border. If there is a load securement violation, the carrier and driver are the ones cited. Sealed loads may also create safety risks apart from compliance issues. The driver may not know how a partial load is packed. Knowing this would help the driver avoid load shifts. She believed that cargo securement regulations and enforcement should be directed toward shippers when they pack the load, and especially when the load is sealed.<br><br>Another regulatory/enforcement complaint concerned small non-CMV trucks (e.g., pickups) that are overloaded and/or have gross vehicle deficiencies, which can be substandard and extremely hazardous, but are rarely subject to any kind of police enforcement because they are not CMVs. "What's wrong with this picture?" she asked. Another complaint concerned inspection station design. She described a scale where there was insufficient distance from the scale pad to the end of the merge ramp to permit a fully loaded truck to accelerate to more than about 45 mph before entering the stream of traffic traveling about 75 mph.<br><br>Although the interviewee expressed many negative views on enforcement, it wasn't "personal." The company is located just one kilometer from a truck scale. She knows "all the scale masters" and sometimes stops in to chat and ask questions. |

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| **Most Important Areas of Safety Management** | In Question 31, driver selection and hiring (a), loading/cargo securement (g), and vehicle safety equipment (h) were rated as the most important. Carrier A's day-to-day safety practices are overwhelmingly related to vehicle maintenance and cargo securement. Regarding vehicle problems, the interviewee said that if there is "anything DOT (regulation-related), it doesn't go down the road." |
| **Effective Safety Management Practices** | Management practices used and rated effective include driver safety bonuses (20), web-based training (21), vehicle PMs (26), detention fees (27), reimbursing tolls (28), tracking company safety statistics (29), and participating in peer meetings (30). Although the company is just three people, it does have formal procedures. For example, the interviewee keeps abreast of new safety regulations and other developments. She does this online and by purchasing safety manuals. She often makes copies of these documents for circulation among the three drivers. She also writes memos and puts them in the third driver's pay envelope to ensure that he sees them. Because of the company's extensive travel in the United States, it must stay apprised of both Canadian and U.S. regulations and other transport matters. |
| **Desired or Planned Enhancements** | The company is hiring a fourth driver, the interviewee's son, who is himself an experienced CMV driver. It previously had a fourth driver; however, this driver left the company "by mutual agreement." The principal performance issue related to his care of his vehicle; for example, the oil level was frequently low. A driver who does not take care of his truck's mechanical condition is not looking out for safety either. |
| **Small Carrier Advantages/ Disadvantages** | Small carrier safety management is hands-on. The manager is directly involved and personally maintains and inspects vehicles. If there is a DOT issue, everyone experiences it directly. The problem has to be fixed before the vehicle goes on the road. On the other hand, cash flow problems greatly limit new investments; the focus is on essentials, not optional enhancements. |
| **Other Comments/ Lessons Learned** | Be prepared for a lot of headaches. Stay on top of safety at all times. Keep up with new safety regulations. If a vehicle develops a safety violation on the road, you must stop and fix it. Otherwise, keep the truck running and fix it at home to save time and money. Small carriers do not have much clout and others will take advantage of that. "Be strong and stand up for your rights," she said. |

**Carrier B, National TL Lease Operator**

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| **Carrier B Description** | Carrier B is a lease operator providing drivers and tractors to two national TL carriers. It has five trucks. It owns its trucks and employs its drivers, but operationally they work for two other companies with the DOT as the operating authority. The arrangement permits the client carriers to increase their fleet and driver counts without making capital investments. The company plans to grow to approximately 12 trucks before it acquires its own operating authority. It has one nondriver employee who does bookkeeping. |
| **Interviewee and Job Description** | The interviewee is Carrier B's owner. He had a 25-year career as a construction manager, but left construction owing to the economy and because he tired of excessive travel and relocations. He then worked for two years as an operations manager for another trucking company. Next he developed a business plan for Carrier B and started the company two years ago. His job as owner/manager encompasses both vehicle and driver management. It does not include those operational management duties (e.g., dispatching) that are handled by its clients. |
| **Biggest Safety Problems and Challenges** | On the survey questionnaire, at-risk driving behaviors (2) received the highest rating as a safety challenge. Other problems rated highly included lack of basic driving skills among drivers (1), driver fatigue/drowsiness (3), driver turnover (9), loading and unloading delays (10), and nondriving injuries (11). Driver management is inherently more challenging and problematic than vehicle management. One can be entirely proactive on vehicles, but drivers can be unpredictable. Problems often reflect an interaction between driver personality and their personal problems. Personal |

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| | issues include both family and financial problems. A happy driver is usually a safe driver. The interviewee believed that driver distraction owing to personal problems was often a stronger and more frequent distraction than that from cell phone use or other driving-specific distractors. Younger commercial drivers are another potential problem, especially when they have not matured enough to be career-oriented. The lowest-risk driver is one who is middle-aged, happy, and productive. |
| **CSA Challenges and Comments** | In survey Question 15, Unsafe Driving (a) and Driver Fitness (c) were rated as the most challenging CSA BASICs. Vehicle Maintenance (e) and Cargo Securement (f) were the least challenging. He believes that CSA often punishes drivers when carriers are primarily to blame. Examples include cases where there are vehicle deficiencies that a carrier should have fixed and when dispatchers "force drivers toward HOS violations and drivers pay the price." |
| **Most Important Areas of Safety Management** | On survey Question 31, the interviewee identified driver selection and hiring (a), driver evaluation (b), and vehicle maintenance (i) as the most important areas of carrier safety management. In comments, the interviewee emphasized the challenge of finding good, qualified drivers. Motor Vehicle Records (MVRs) and Pre-employment Screening Program (PSP) reports are helpful, but they must be interpreted carefully. For example, crash involvements may be not-at-fault, and roadside vehicle violations may reflect more on carrier deficiencies than on drivers. In contrast, moving violations such as speeding reflect directly on the driver. It is important that an owner/manager ensure that every equipment item is in tip-top shape. Managers must know their equipment and address every problem, no matter how small. |
| **Effective Safety Management Practices** | Three specific practices used and rated effective are driver candidate road/range tests (17), a selection questionnaire on driver attitudes and driving behaviors (18), and regular safety meetings (19). The company also employs a number of the other practices on the questionnaire, although the owner was less convinced of their safety effectiveness. This included the use of EOBRs (23) and charging detention fees (27). A risk of using EOBRs, the interviewee said, was that managers use the detailed data to micro-manage drivers, thus alienating them. Carrier B's owner strives continuously to keep his drivers happy. For example, he compensates them for excessive downtime even if the company is not being compensated. "I take care of them before I take care of myself," he said. Drivers need to be treated respectfully, as adults. They need to be empowered to make their own decisions, but they also need to be "coddled" so they do not become disgruntled. A driver who is not communicating from the road is likely to be unhappy or angry for some reason. The owner encourages them to contact him with any problem. He tells them, "Don't get [ticked] off at anyone but me." When drivers are on longer trips the owner sometimes checks in with their families to be sure everything is okay. The object is not to pry, but rather to keep communications open in case there is a problem. With regard to driver rewards for safety, the interviewee noted that money is not always the best motivator. Being able to drive a newer truck or one equipped with satellite radio may be a more effective motivator than an equivalent, or even larger, cash reward. |
| **Desired Planned Enhancements** | The carrier has no immediate plans for changes. If the owner/manager were able to hire an assistant manager, that person would share safety management along with other duties. However, there are difficulties in growth. It adds layers to management and it is hard to find new managers with the same values and standards. |
| **Small Carrier Advantages/ Disadvantages** | Small carriers can invest time and attention in each driver. The owner/manager can be aware of everything going on with each driver and each vehicle and can respond immediately to concerns. The interviewee saw no major safety disadvantages to being small, although he noted that company insurance costs would likely be smaller if the company were bigger. |
| **Other Comments/ Lessons Learned** | Consider the financial rewards of safety and losses from crashes. Crashes mean financial loss. Better to pass up an additional load than to create a situation where a driver is stressed out and in a hurry. Treat both your drivers and your company image like gold. |

**Carrier C, Regional Heavy-Load TL**

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| **Carrier C Description** | Carrier C is a regional TL carrier with six power units. It operates in a northern state that allows heavier and more productive trailers than most other states. Its tractors typically pull 8-axle "B-Trains" with a total gross vehicle weight rating of 160,000 lb, twice that of a conventional tractor semitrailer. Carrier C hauls steel coils in dedicated service to a steel company, and also carries lumber and brick products for various shippers. Most of its driver trips are less than 400 miles each way, and drivers are almost always home for weekends. The company has no full-time non-driver employees. |
| **Interviewee and Job Description** | The interviewee is the company owner and sole manager, who has owned the company for 36 years and has 42 total years in CMV operations. Other than driving, he performs virtually all company tasks including administration, personnel, sales, vehicle inspections and repairs, supervising loading and unloading, operational management, and safety management. He could not assign a percentage to his safety-related tasks because he believed that safety management is ongoing and permeates all his work. Until about ten years ago, he managed the company while still driving part-time. He found that he could not be both a good driver and good manager once the company had three trucks. In general, he spends more time on vehicle safety than on driver safety, because of the size of his rigs (e.g., 20 brakes and 42 tires, versus 8 brakes and 18 tires for a conventional rig) and because the company has a mature and stable group of drivers. |
| **Biggest Safety Problems and Challenges** | The most highly rated problems on the questionnaire included lack of basic driving skills (1), at-risk driving behaviors (2), driver fatigue (3), driver selection and hiring (6), rewarding/disciplining drivers (8), and driver turnover (9). Because of the company's large vehicles and loads, emphasis is placed on vehicle maintenance and cargo securement. When each truck has 42 tires and 20 brakes, much time is spent on tire and brake inspection and maintenance. Cargo securement is important both from the respect of preventing a cargo-related crash and preventing driver injuries that might occur during loading and unloading. Empty backhauls are somewhat of a problem because Carrier C's specialized trailers make it difficult to book return loads. Its main dedicated service to a steel coil producer involves only one-way trips. Carrier C trucks make numerous trips to Canada and thus encounters border delays. These delays are tiring for drivers because trucks must move slowly through a queue under often-unpleasant conditions. He believed that border crossings were often poorly designed physically and that their operations could be improved. |
| **CSA Challenges and Comments** | In survey Question 15, Fatigued Driving/HOS (b) and Vehicle Maintenance (e) were rated as the most challenging CSA BASICs. Alcohol/Drugs (d) and Crash History (g) were the least challenging. CSA is a greatly magnified challenge for Carrier C and others pulling multi-axle trailers. Vehicle inspection records are based primarily on the *number* of violations found. Given equal maintenance, trucks with more brakes and more tires will incur correspondingly more violations. Because of this, Carrier C must be "obsessive" about brake and tire inspections and maintenance. The interviewee believed that CSA tabulations might take this factor into account. "They should compare apples to apples," he said. Overall, the interviewee supported CSA but felt that "they haven't fine-tuned it yet." For example, an inspector could make a completely erroneous observation that could not later be appealed. CSA does make it easier to hire safe drivers because of the records generated on each driver. Drivers "feel the pressure" from CSA, he said. |
| **Most Important Areas of Safety Management** | In Question 31, driver selection and hiring (a), scheduling/dispatching (e), and vehicle maintenance (i) were rated as most important. As already noted, Carrier C's large trailers require closer inspections and more maintenance than conventional trailers. Driver selection and hiring are of high importance for CMV transport in general, although Carrier C has few driver problems because of the high pay and relatively attractive work schedules it offers. When driver problems do arise, approximately half are related to personal situations, such as financial problems or "girlfriends." |
| **Effective Safety Management Practices** | Management practices used and rated effective include road/range screening tests (17), applicant questionnaire on driving behaviors (18), safety meetings (19), in-house training media (22), fuel economy monitoring (24), vehicle PMs (26), detention fees (27), reimbursing tolls (28), tracking |

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| | company safety statistics (29), and participating in peer meetings (30). Carrier C has had no major crashes and no significant nondriving injuries. The interview attributes this to an "obsession" with vehicle maintenance, a mature and elite group of drivers, and to proactive operational planning. Because the company carries large payloads, it is able to pay its drivers approximately 40% more than they would make pulling conventional trailers; thus, Carrier C can be selective. And, because of its small size and many years in the business, its owner knows his own drivers extremely well and also knows other qualified drivers available as potential hires. Drivers are home every weekend. This and good pay keeps Carrier C's annual driver turnover rate at less than 10%. Carrier C monitors vehicle speeds using onboard computers, but does not frequently see unsafe readings. Drivers are treated as mature adults and are empowered to manage their own time when on the road. If they feel tired, they can stop for rest. Trailer loading and unloading and cargo securement are more strenuous tasks than with conventional operations; therefore, Carrier C drivers tend to be in better physical condition than seen elsewhere in the industry.<br><br>The interviewee believed that Carrier C's driver hiring standards were very high. The company is able to hire middle-aged drivers with years of experience and clean driving records. Most new drivers are already known to the company. Driver appearance and comportment are also important criteria. A driver with "a pony tail and his hat on backwards" would not be hired. The condition of a driver's personal vehicle is also taken as a safety and performance indicator. |
| **Desired or Planned Enhancements** | In general, the interviewee believed that his current approach to safety management and safety equipment for his trucks was working and needed no major improvements. One might think that Tire Pressure Monitoring Systems would be high on Carrier C's wish list, but they had been tried and found not to function well during the region's cold winters. Manual checks work better. One technology of interest was trailer disc brakes because of their better reliability and an absence of brake fade. [Note: New air disc brake designs have many potential advantages over drum brakes, including less need for adjustment, more precise control and modulation by drivers, far less susceptibility to brake fade as a result of heat buildup, easier maintenance, and better vehicle stability during hard stopping. Stability benefits are achieved by a more uniform distribution of braking force across multiple wheels (Knipling 2010).] |
| **Small Carrier Advantages/ Disadvantages** | Small carriers have direct contact with their drivers, vehicles, and customers. They have the operational flexibility to provide superior service to their customers. The driver is "not a number" and the manager knows everything that transpires. However, to be successful, a small company must find its niche. There are no significant safety disadvantages to being small. |
| **Other Comments/ Lessons Learned** | The company's insurance carrier has provided ample good safety assistance over the years. For example, it provides maintenance and driving training materials and a safety newsletter for employees. |

**Carrier D, Short-Haul Dedicated Service TL**

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| **Carrier D Description** | Carrier D has six trucks and makes short-haul runs, mostly under contract with the U.S. Postal Service. Its six trucks include one tractor–semitrailer and five straight trucks. Most trips are same-day out-and-backs to other Georgia cities such as Augusta or Macon. Apart from the owner–manager, the company has one full-time administrative employee and a part-time mechanic. |
| **Interviewee and Job Description** | The interviewee started the company 24 years ago as a driver–manager, and still drives two days a week. The rest of his time is spent on a variety of tasks, with roughly 40% of management time focused on safety. Within the time spent on safety, roughly 50% is spent on vehicle inspection and maintenance, 20% on hiring and training, 20% on evaluating and disciplining current drivers, and 10% on dealing with DOT compliance matters. |

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| **Biggest Safety Problems and Challenges** | Highly rated problems on the questionnaire included a lack of basic driving skills (1), at-risk driving behaviors (2), driver fatigue (3), driver selection and hiring (6), assessing driver on-road safety (7), rewarding/disciplining drivers (8), driver turnover (9), and loading and unloading delays (10). Carrier D's driver turnover is high; approximately two-thirds of his drivers turn over each year. Of departures, "half leave for reasons, half for cause," the interviewee said. The most frequent causes are failure to follow instructions and comply with rules. A few cases have been worse; for example, larceny and intentional damage to vehicles. On a daily basis, compliance issues loom larger than noncompliance-related safety issues. Among at-risk driving behaviors, driver fatigue and speeding were mentioned as concerns. |
| **CSA Challenges and Comments** | In survey Question 15, Driver Fitness (c) and Vehicle Maintenance (e) were rated as the most challenging CSA BASICs. Fatigued Driving/HOS (b) and Crash History (g) were the least challenging. DOT inspections are performed differently in different states, the interviewee believed, and states are "hungry for revenue." Company drivers must also negotiate a crazy quilt of road and parking restrictions across six different municipalities in greater Atlanta, and others elsewhere in the state and beyond. He felt that delays and fines made it very difficult for small carriers to operate profitably. Carrier D's principal customer, the U.S. Postal Service, also inspects its vehicles every four years, although this was not viewed as problematic. |
| **Most Important Areas of Safety Management** | In Question 31, driver selection and hiring (a), driver evaluation (c), and vehicle maintenance (i) were rated as most important. On a daily basis, more time was spent on vehicle maintenance than on other areas, and this was driven largely by the threat of inspection violations and fines. |
| **Effective Safety Management Practices** | On the survey form, vehicle PMs (26) was the only safety practice used by the company and rated as effective. In comments, the interviewee also described a driver safety and performance bonus system whereby drivers could receive a $10 daily bonus based on criteria such as no crashes or tickets, arriving on-time for work assignments, and not turning down runs. Drivers could earn up to about $200 per month in bonuses. Carrier D finds potential driver hires through the Georgia Department of Labor, which does preliminary screening for experience, job performance record, and "retention skills." Carrier D prefers short-haul runs that bring drivers back daily or with one overnight stay. "Further away, and it is harder to make money and get back safely. The farther away from shore, the deeper the water and the more sharks." In addition, crossing state lines means stops at weigh stations and inspections where trucks may be subject to violation citations related to state-specific inspection practices. |
| **Desired or Planned Enhancements** | The interviewee would like to hire a full-time mechanic who would also inspect vehicles for safety and compliance. He would like also to equip its vehicles with global positioning system (GPS) units to aid driver navigation and to provide data on vehicle speed and location. |
| **Small Carrier Advantages/ Disadvantages** | In a small company it is easier to "weed out weak drivers" and otherwise manage drivers because the manager knows them better. There is one central location and the manager sees each driver almost every day. For example, one can watch them do pre- and post-trip inspections. On the other hand, a larger company is likely to have extra vehicles so it can take them out of operational service to receive thorough maintenance. This is difficult for Carrier D because it generally must run every vehicle every day. |
| **Other Comments/ Lessons Learned** | Companies need to know a lot about DOT regulations because there is such an adversarial atmosphere. Small businesses are being forced out of the marketplace, independently of safety. Strong financial backing is needed to overcome setbacks. "If you cannot navigate the 'deep waters' with DOT from the start, I would not advise going swimming." In addition to competence in truck transport *per se,* company managers need a lot of administrative support and training on matters such as DOT regulations, fuel costs, and insurance.<br><br>Carrier D was close to bankruptcy a few years ago when the company had only two trucks. While driving a tractor–semitrailer, the interviewee was involved in a road departure crash, which was |

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| | attributed to faulty brakes on a trailer leased from a leasing firm with responsibility for its maintenance. The crash broke his arm in two places, but he was unable to get treatment for nearly a month owing to lack of medical insurance. He could not drive for a year following the crash. Somehow, he was able to keep the second truck running and the company barely survived. Since then, the carrier has grown to six trucks. However, company survival and growth has been a constant struggle, he said. |

**Carrier E, Regional Flatbed TL**

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| **Carrier E Description** | Carrier E is a regional TL flatbed carrier in the Midwest. The company has nine power units and mainly hauls lumber and bales of cardboard. The company owns a repair shop and employs three mechanics. In recent years it has expanded its business to include repairs and roadside service. |
| **Interviewee and Job Description** | The owner and his son started the business nine years ago. The owner had previously been a building inspector and had never been a commercial driver. His job encompasses all aspects of management, with safety management as a principal activity. His son is the company dispatcher and also runs the repair shop. |
| **Biggest Safety Problems and Challenges** | Among the biggest challenges identified on the survey questionnaire were difficulties recruiting and selecting good drivers (6), loading and unloading delays (10), and nondriving injuries (11). Loading/unloading delays are a problem because the company often books loads through brokers and must collect detention fees from them. Carrier compensation depends on the broker collecting the charge from the customer. Detention fees are not an effective deterrent; however, having drivers call the broker immediately upon arrival at a location helps to reduce the problem. Although the company has never lost a load off its trailers, cargo securement is an everyday concern in flatbed operations. Speeding is the at-risk driver behavior of greatest concern. Carrier E's trucks are governed for top speed; however, governors do not affect driver speed choices on lower speed roads. A specific problem facing flatbed operations is that its physical requirements relating to cargo securement make it a "young man's game." Yet young drivers without two or more years of experience are often difficult to insure. |
| **CSA Challenges and Comments** | In survey Question 15, Fatigued Driving/HOS (b) and Cargo Securement (f) were rated as the most challenging CSA BASICs. Alcohol/Drugs (d) and Crash History (g) were the least challenging. The company had undergone a CSA audit and passed. The auditors identified three Carrier E drivers flagged by CSA as deficient, but all three had already been terminated by the company for safety reasons. The Carrier E owner frequently reminds his drivers to guard against getting "stupid tickets" in roadside inspections. This includes logbook violations, small vehicle violations such as missing lights, and other easily avoidable violations. The interviewee believed that federal safety rules were generally fair, but that there were "too many gray areas" in enforcement. Further, he believed that some inspectors acted unreasonably, as if they were "on a power trip." Having previously been a building inspector, the interviewee was sensitive to the difference between inspectors who made objective judgments and those who did not. With regard to HOS rules, the company instructs its drivers not to split sleeper berth off-duty periods because it was too easy to confuse the rules and incur a violation. Instead, it was better to stick with a standard 14-hour tour-of-duty followed by ten hours off. The company does not have a crash history problem, but its owner worries that just a few crashes, even not-at-fault crashes, could raise its Crash History BASIC score to deficiency status, which has happened to other small companies. |
| **Most Important Areas of Safety Management** | On survey Question 31, the interviewee identified driver selection and hiring (a), training and communications (b), and monitoring carrier performance measures (j) as the most important areas of carrier safety management. The key to effective driver screening is identifying specific risk indicators in applicants, such as a record of driver violations in roadside inspections. In his comments, the interviewee also emphasized the importance of loading and cargo securement (g) in flatbed operations. |

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| **Effective Safety Management Practices** | Specific management practices used and rated effective include road/range tests (17), driver bonuses for safe driving (20), use of training media in-house (22), monitoring individual driver fuel economy (24), vehicle PMs (26), reimbursing tolls (28), tracking company safety statistics (29), and participating in peer meetings (30). Carrier E has a "three strikes and you're out" speeding policy. A driver's first speeding ticket brings a warning, the second a 3-day suspension, and the third possible termination. The Carrier E owner conducts safety meetings with his drivers, but finds that short, to-the-point 5- to 10-minute meetings deliver safety messages more forcefully than longer meetings. Carrier E documents almost all of its safety policies in writing (as encouraged by the DOT), and frequently includes safety handouts or policy statements with driver paychecks. The company uses FMCSA's Pre-Employment Screening Program (PSP) enthusiastically. A driver can have a clean MVR with regard to moving violations, but still have a record of crashes and roadside violations as revealed by a PSP search. Only about one-third of Carrier E's drivers turn over annually; the low rate was attributed to the fact that its drivers are home almost every weekend. |
| **Desired or Planned Enhancements** | If Carrier E had more resources, it would upgrade its fleet by buying newer trucks. Tire pressure monitoring systems were mentioned as a specific technology on its shopping list. |
| **Small Carrier Advantages/ Disadvantages** | One small carrier advantage is the flexibility to change in its runs and customers if conditions change or new opportunities emerge. Also, a small carrier can have more informal and personal customer relationships. A disadvantage is a lack of resources to purchase new trucks and safety devices. |
| **Other Comments/ Lessons Learned** | "Go the extra mile for safety because it will come back to bite you if you don't. Do lots of training. Play by the rules." DOT rules are generally fair but some DOT officers are "on a power trip" and their decisions can put a small company out of business. |

**Carrier F, National Flatbed TL**

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| **Carrier F Description** | Carrier F is a national TL flatbed carrier based in the Midwest. It has ten power units and carries a variety of flatbed cargo. The company has been in operation for seven years. |
| **Interviewee and Job Description** | The company owner and chief executive officer (CEO) had been a driver and manager for other companies for nearly 20 years before starting his own company. He is involved in all areas of company management, including administration, accounting, personnel, sales, dispatching, and contracting for vehicle maintenance. He spends approximately 10% of his time specifically on safety management, in particular driver training and orientation. Three nondriver employees include a sales person, dispatcher, and bookkeeper. |
| **Biggest Safety Problems and Challenges** | Highly rated problems on the questionnaire included at-risk driving behaviors (2), assessing driver on-road safety (7), rewarding/disciplining drivers (8), driver turnover (9), nondriving injuries (11), and lack of sufficient management time (12). Addressing driver problems and incidents on the road is a challenge. It is "hard to find solutions" when dealing with a problem remotely. His approach is to stay positive and try not to place blame. Driver retention is a challenge, but the company is able to keep turnover below 30% by paying drivers more and "treating people with respect, fairly and consistently." A few nondriving accidents involving drivers have caused the company particular difficulty. The interviewee believed that some employees abuse workers' compensation rights. "You couldn't dream up some of the claims we get," he said. |
| **CSA Challenges and Comments** | The company had already received a CSA audit and had "passed easily." In survey Question 15, Fatigued Driving/HOS (b) and Cargo Securement (f) were rated as the most challenging CSA BASICs. Alcohol/Drugs (d) and Crash History (g) were the least challenging. Cargo securement |

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| | "nails every flatbed carrier," the interviewee said. He believed that inspectors were not adequately trained and that securement rules were not interpreted and enforced consistently. This is a problem for cargo securement in general, but especially for flatbed cargo. HOS rules would be easier to follow if they allowed drivers more flexibility. |
| **Most Important Areas of Safety Management** | In Question 31, driver selection and hiring (a), driver performance consequences (d), and vehicle maintenance (i) were rated as most important. In comments, the interviewee emphasized new driver screening. This includes driver background checks, road/range tests, and other screening practices. A mandatory 90-day provisionary period for new hires may be extended if they show marginal performance. |
| **Effective Safety Management Practices** | Management practices used and rated effective include road/range screening tests (17), safety meetings (19), in-house training media (22), fuel economy monitoring (24), vehicle PMs (26), detention fees (27), and reimbursing tolls (28). As noted earlier, driver hiring was regarded as paramount. Evaluating drivers' on-road safety is challenging, but also important. Managers need to investigate any incident reports (e.g., call-ins) and ask customers about driver behavior at their terminals. The company pays drivers a small bonus for each clean inspection. The interviewee believed that the positive recognition was a stronger motivator than the money itself. Drivers can also be docked for bad inspections. |
| **Desired or Planned Enhancements** | Given more time, money, and other resources, the company would like to have a designated safety manager, have its own repair shop, equip vehicles with advanced safety technologies, and purchase more management software. |
| **Small Carrier Advantages/ Disadvantages** | In a small company, the manager can know every driver and his/her strengths and limitations. In larger companies, "the driver is a number." Most of Carrier F's drivers have previously driven for larger companies and did not like them. The biggest disadvantage is lack of resources to invest in safety; that is, no "deep pockets." |
| **Other Comments** | Company safety is motivated by many different external forces, including government enforcement, insurance costs, and company image; yet, most importantly, safety is the "right thing to do." Trucking is a difficult and fickle business. It is hard to keep up with everything. |

**Carrier G, National Refrigerated TL**

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| **Carrier G Description** | Carrier G is a national TL carrier in the Midwest. The company runs 12 trucks, which are driven by owner–operators under contract. The company assists new owner–operators in financing their truck purchases while driving for the company. Refrigerated food products are its primary cargo although it also carries dry freight. In addition to its drivers, the company employs a dispatcher and accounting staff. A sister company under the same ownership purchases additional trucks and leases them to carriers. The company contracts out its truck maintenance. |
| **Interviewee and Job Description** | The owner/interviewee has 35 years experience in trucking. He has been a company driver, owner–operator, and a manager with a large TL carrier. He is a certified driver trainer in his state. His managerial responsibilities cover a range of tasks, with approximately 25% of his time focused on safety. |
| **Biggest Safety Problems and Challenges** | Among the biggest challenges identified on the survey questionnaire were driver health and wellness (4), driver personal problems (5), recruiting and selecting good drivers (6), correctly rewarding and disciplining drivers (8), and driver turnover (9). Carrier G faces an added challenge in recruiting because it hires only owner–operators, most of whom purchase their trucks with the assistance of the company. Thus, Carrier G drivers must be *entrepreneurial* and financially responsible in addition to being safe. Only about 10% of driver inquiries become new hires, thus making driver screening a labor-intensive process. |

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| **CSA Challenges and Comments** | In survey Question 15, Fatigued Driving/HOS (b) and Vehicle Maintenance (e) were rated as the most challenging CSA BASICs. Unsafe Driving (a) and Crash History (g) were the least challenging. The interviewee believed that "CSA intentions are good" and that the overall program is effective. However, in some respects it is overly ambitious. |
| **Most Important Areas of Safety Management** | On survey Question 31, the interviewee identified driver training and communications (b), driver rewards and discipline (d), and vehicle PM (i) as among the most important areas of safety management. In addition, the criticality of driver selection and hiring was mentioned in comments. |
| **Effective Safety Management Practices** | Specific management practices used and judged effective included vehicle PMs (26), charging detention fees (27), reimbursing tolls (28), tracking company safety statistics (29), and manager participation in peer meeting (30). The interviewee believed that it is natural for drivers to want to transition to becoming owner–operators after 3 to 5 years of company driving. Carrier G's hiring and management system was set up to foster this. Thus, Carrier G's drivers are somewhat like business partners, rather than simply being employees. Carrier G produces a monthly company newsletter directed primarily toward its drivers, with much of its content relating to safety awareness. |
| **Desired or Planned Enhancements** | As part of its continuing efforts to advance, Carrier G is installing tracking equipment on all its trucks. The new system permits continuous tracking of vehicle location, trip history, moving speed, idle time, fuel use, maintenance status, and other operations- and safety-related parameters. The interviewee noted that the company's insurance carrier offers various safety programs to its customers, such as driver safety training programs and management software. They have yet to take full advantage of these offerings but plan to do so. |
| **Small Carrier Advantages/ Disadvantages** | Carrier G's owner believed that his small, "family-oriented" company fosters a personal relation with drivers, and thus can have high performance and safety expectations of them. There is a two-way personal commitment. In larger companies the driver may be "a number" and there is likely to be more waste and lowered standards. He believed that his company exercised strong leverage over its owner–operator drivers because of their contractual and personal relationship. A difficulty for small carriers, and for the industry in general, is in making a profit and helping drivers to make a good living. Carriers and drivers want to be safe, but those not making a good living will tend to "run against" the clock and safety rules. |
| **Other Comments** | Carrier G strives to closely follow mandatory and other established safety practices. It is a constant challenge to make trucking both productive and safe. Truck driving is a hard job and most drivers want more flexibility in how they manage their time and work. |

**Carrier H, National Long-Haul TL**

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| **Carrier H Description** | Carrier H is a national long-haul TL carrier with 26 trucks. It hauls parts for a major auto manufacturer in dry van trailers, and also serves other customers. Although the company runs nationally, more than 90% of its operations are in the Midwest. Nondriver employees include office staff, two dispatchers, mechanics, and a safety director/driver trainer. Approximately 60% of Carrier H drivers are owner–operators. |
| **Interviewee and Job Description** | The interviewee is the president and owner of the firm, which he founded eight years ago. Before that, he drove for 18 years, both as an owner–operator and company driver. Although he has many other management responsibilities, he is heavily involved in company safety. He participates in applicant screening and "has the final say" on hiring. He also conducts many safety meetings and oversees a driver safety bonus program. His safety director trains drivers, reviews logs, and maintains compliance files, among other tasks. The interviewee had been both general manager and safety director until the company's size reached 18 trucks. At that point, a separate safety director was needed. |

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| **Biggest Safety Problems and Challenges** | Highly rated problems on the questionnaire included lack of basic driving skills (1), at-risk driving behaviors (2), driver fatigue (3), and loading/unloading delays (10). The interviewee believed that driver misbehavior (e.g., tailgating and aggressive driving) was a bigger safety problem than performance failures (e.g., fatigue), although both are important. He believed that the driver fatigue problem had been made worse by current HOS sleeper berth rules limiting the shorter split-sleep period to two hours. From his own driving experience and that of his employees, he believed that 6-4 and 5-5 splits were more natural and restorative than an 8-2 split. Shippers often threaten safety by demanding tighter delivery schedules. "They can always find a carrier who will run 15 hours (rather than 14, the legal maximum)," he said. Shippers have improved in recent years but the problem is still there. Sometimes his drivers experience 6 to 8 hour loading and unloading delays. Carrier H charges (and usually collects) detention fees in such cases and compensates its drivers; however, such delays are still disruptive to operations and to drivers' personal lives. |
| **CSA Challenges and Comments** | In survey Question 15, Fatigued Driving/HOS (b) and Crash History (g) were rated as the most challenging CSA BASICs. Alcohol/Drugs (d) and Cargo Securement (f) were the least challenging. Carrier H regularly checks its CSA Safety Measurement System (SMS) scores, and the interviewee was familiar with CSA practices. He complained that traffic violation "warnings are the same as a ticket in CSA. The only difference is the fine." The company had to fire a driver who had had three speeding warnings, but no tickets. The Crash History BASIC is a problem because it includes all crashes, regardless of preventability. Carrier H had had seven crashes, but four were nonpreventable. Two others were minor preventable crashes in which company drivers were not charged. One, however, was a fatal, single-vehicle crash as a result of a driver medical failure. The company had been subjected to a DOT audit because of the fatal crash. |
| **Most Important Areas of Safety Management** | In Question 31, driver selection and hiring (a), driver evaluation (c), and scheduling/dispatching (e) were rated as most important. In comments, the interviewee emphasized the importance of hiring the right people and also to responding immediately to reports of driver misbehavior. |
| **Effective Safety Management Practices** | Management practices used and rated effective included road/range screening tests (17), bonuses/rewards for safety (20), web-based training programs (21), training in-house media (22), vehicle PMs (26), reimbursing tolls (28), and tracking overall company safety statistics (29). In addition to taking road/range driving tests, driver applicants must perform a pre-trip vehicle inspection as part of screening. Applicant "red flags" include anger issues, bad driving history, and frequent job changes. The company pays an outside source for driver background checks, but the process may take two weeks or more. A better system is needed, the interviewee believed.<br><br>Carrier H's vehicles are not equipped with On-board Safety Monitoring (OBSM) computers; it had used them in the past but did not continue, in part as a result of cost. Instead, it has its trucks' engine Electronic Control Modules (ECMs) read quarterly at a truck dealership. For a fee of $50, the dealer reads the ECM and prints out a 5 to 6 page report with safety indicators such as overspeeds, hard braking events, and fuel mileage. Drivers can earn a safety bonus twice a year if they have no tickets, warnings, or vehicle damage. For every clean inspection, the driver earns a chance to win $100 in a drawing. Drivers also receive an annual $100 bonus for every year they have been with the company. Although these bonuses are not substantial in relation to overall driver earnings, they are effective motivators and contribute to company esprit de corps. Any customer or public complaints about a driver are taken "very seriously." Although infrequent, such complaints might involve aggressive driving behaviors such as intimidation of other vehicles by tailgating.<br><br>Carrier H has excellent safety partnerships with both its main customer and with its insurance provider. The auto company provides training videos on yard, dock, and loading safety. The insurance carrier provides videos and printed material on safe driving techniques and avoiding nondriving injuries such as slips and falls. |

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| | The interviewee and his safety director attend truck shows, where they may receive training and information on both business and safety practices. Carrier H shares safety information, resources, and ideas with one other company that has a similar operation. |
| **Desired or Planned Enhancements** | Carrier H does not currently use EOBRs; however, the interviewee would like to install them. He believed that they would help to reduce loading and unloading delays by making shippers realize that HOS rules could not be broken. He also favored an EOBR mandate to "even the playing field." |
| **Small Carrier Advantages/ Disadvantages** | Even a small carrier has a wide array of business, operational, and safety issues to address. As a carrier grows, it inevitably must hire additional managers. Although growth provides more resources, it creates problems of its own. |
| **Other Comments/ Lessons Learned** | A small carrier manager cannot get behind on safety or on anything. He or she must always be proactive and cannot cut corners. In addition to things carriers can do, desired external changes include more flexibility in the HOS sleeper berth rule, stricter enforcement of trucks entering the United States, and easier access to driver applicant employment records. Finally, the interviewee believes that carriers who undercut the competition on rates are almost inevitably unsafe, because they must skimp on safety to achieve low costs. Although the government probably cannot set minimum rates, it could figure out a way to stop this. |

### BUS COMPANIES

The two bus companies represented included a charter company with 15 buses and a large transport company owning 26 smaller subsidiary bus companies. The large company, Carrier J, was included because of its management activities overseeing the operations of its 26 smaller subsidiaries.

#### Carrier I, Bus Charter

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| **Carrier I Description** | Carrier I is a charter bus operation based in Pennsylvania. The company has 15 buses and employs 9 full-time and 25 part-time drivers. The company has operated for 30 years. Most of its trips are in the Northeast, but some go to Canada and the western United States. The company employs 11 nondriver employees, including sales/customer service representatives, mechanics, a bookkeeper, and a dispatcher. It is in the process of hiring a new driver trainer who will have other safety-related responsibilities. |
| **Interviewee and Job Description** | The interviewee was the vice president and general manager of the company. His father founded the company and is president, but is transitioning toward retirement. The interviewee has 11 years experience with the company. He has no experience as a driver and does not have a CDL. His job encompasses all aspects of general and operational management. Approximately 10% of his time is "directly" tied to safety, but much more time is indirectly related. He oversees all safety activities, but does not conduct driver safety training because he is not a driver. He obtained much of his ongoing management development through industry trade association meetings and seminars, which he finds beneficial. |
| **Biggest Safety Problems and Challenges** | Highly rated problems on the questionnaire included at-risk driving behaviors (2), driver fatigue (3), driver selection and hiring (6), assessing driver on-road safety (7), rewarding/disciplining drivers (8), and lack of training materials for both drivers and managers (13, 14). The interviewee believes that driver safety was far more challenging than vehicle safety. If one does vehicle PMs, repairs, and inspections systematically, vehicle-related safety and compliance problems largely disappear. This is not possible with drivers. They are more variable and "out there on their own." Monitoring drivers for safety is more problematic than hiring or training them. Of most concern are driving behaviors such as tailgating, cutting-in, and red light running. These behaviors generally must be observed directly and cannot be easily detected and documented |

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| | through onboard monitoring. Driver performance issues such as fatigue and health and wellness are also a concern, especially because most of Carrier I's drivers are middle-aged or older. |
| **CSA Challenges and Comments** | Regulatory compliance was not regarded as a major challenge by the interviewee. The company has had few bad inspections; the most recent was a log paperwork violation 18 months ago. The company has progressed "beyond compliance" in its safety program. In survey Question 15, Fatigued Driving/HOS (b) and Vehicle Maintenance (e) were rated as the most challenging CSA BASICs. Driver Fitness (c) and Cargo Securement (f) were rated as the least challenging. |
| **Most Important Areas of Safety Management** | In Question 31, driver training and communications (b), scheduling/dispatching (e), and vehicle maintenance (i) were rated as most important. A cross-cutting priority is documentation of safety policies and activities. An example is training; the interviewee would like to have much better documentation of company training programs, including both process and content. Successful small company growth is accompanied by more formalization of policies and practices, and by better documentation. |
| **Effective Safety Management Practices** | Management practices used and rated effective include road/range screening tests (17), safety meetings (19), in-house training media (22), EOBRs (23), fuel economy monitoring (24), vehicle PMs (26), and participating in peer meetings (30). Carrier I vehicles are equipped with DriveCam®, which captured hard braking, hard swerves, and videos of critical events. This has proven very effective, but it does not capture nondynamic events such as tailgating. Carrier I is in the process of equipping its vehicles with GPS devices for navigation and to monitor driver speeds. A responsibility of the new driver trainer will be to regularly monitor these and indicators of driver behavior and risk. Problems are infrequent and addressed on an individual basis. Currently drivers are not given extra rewards for safe driving; the company has abandoned a previous system that degenerated into driver bickering over unreliable indicators such as scratches on vehicles. However, the company is planning to adopt a "Pay for Excellence" system that was developed and used successfully by another company. "Pay for Excellence" was just one idea acquired through Carrier I participation in a 20-carrier idea-sharing consortium organized by the UMA. Participating carriers meet several times annually to discuss all aspects of carrier operations and safety. Carriers within each group are carefully selected to be geographically dispersed and not in direct competition with each other. Approximately 10% of group discussions relate directly to safety.<br><br>Carrier I recently contracted with a new provider of driver physical examinations for medical qualifications. This is to ensure that examinations are rigorous and that drivers meet all physical requirements fully. The interviewee regarded this as a more effective medical intervention than those directed toward current employees. Company training and communications promote healthful driver behaviors; however, there were few indications of success, such as driver weight loss. However, interventions to force specific medical treatments [e.g., continuous positive airway pressure (CPAP) use by a driver with Obstructive Sleep Apnea] had been successful. |
| **Desired or Planned Enhancements** | As noted, the company is installing GPS devices with safety applications such as speed monitoring. It wants to take full advantage of GPS-related safety applications. Carrier I is also developing a more systematic process to monitor driver fuel economy and will be adopting the "Pay for Excellence" reward system mentioned earlier. Although Carrier I regards most of its drivers as safe, it wants to use these techniques to better deal with those at the lower end. With regard to driver training, the interviewee expressed a desire to find better web-based or other training programs on safe driving methods, such as setting mirrors and making safe turns. |
| **Small Carrier Advantages/ Disadvantages** | In a small company, the manager knows everyone directly and can react by "gut instinct," not just based on cold statistics. This is an advantage but also a disadvantage in some respects. Having more statistics based on more data would allow a manager to make more objective, data-driven decisions. |

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| **Other Comments/ Lessons Learned** | "Make sure you have good equipment inspection, listen to mechanics, and pay attention to driver hiring." Company safety standards must be "beyond compliance." Company pride and protecting company image are among the strongest motivators of safety excellence. Bus companies are particularly vulnerable to single, high-exposure crashes or incidents that could irreparably damage a company's reputation. |

**Carrier J, Large Bus Company (Owner of 26 Subsidiaries)**

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| **Carrier J Description** | Carrier J is a passenger carrier with more than 1,000 vehicles. It is included in this study because it owns and oversees 26 smaller companies located throughout the United States. This includes charter services, crew transport, contract services, commuter/transit lines, tours, casino services, and shuttles. Many of their subsidiaries were "Mom and Pop" companies that grew large enough to attract acquisition by Carrier J. Many of the companies are still managed by their original owners. The perspective provided in this write-up is that of a large company overseeing subsidiary operations and thus having insight into their common safety practices and challenges. |
| **Interviewee and Job Description** | The interviewee has 48 years experience in passenger transport. Most of his career was with another large bus company, where he retired as Director of Driver Operations. He has a CDL and conducts driver training, but has never worked as a driver. His experience encompasses both driver and vehicle safety; among his past job titles is Regional Maintenance Manager. He also has experience in sales and marketing. |
| **Biggest Safety Problems and Challenges** | Highly rated problems on the questionnaire included a lack of basic driving skills (1), at-risk driving behaviors (2), driver fatigue (3), driver selection and hiring (6), assessing driver on-road safety (7), nondriving injuries (11), and a lack of training materials for managers (14). The interviewee stated that hiring and retaining safe drivers were the biggest challenges for small bus companies. The operations of many of Carrier J's subsidiaries vary seasonally, which means that they hire new drivers every year. Because of this and normal turnover, hiring and training drivers are continual concerns and activities in most Carrier J companies. Driver safety risk factors include both medical fitness and choice behaviors such as speeding and tailgating. |
| **CSA Challenges and Comments** | In survey Question 15, the interviewee indicated five CSA BASICs of high importance: Unsafe Driving (a), Fatigued Driving/HOS (b), Driver Fitness (c), Alcohol/Drugs (d), and Crash History (g). Carrier J's website lists all its subsidiaries and for each provides current data on their CSA BASICs. This includes on-road inspection data and, when applicable, investigation and BASICs status data. Although overall company safety performance is very good, a few subsidiaries showed HOS and vehicle inspection violations. The interviewee believes that bus charter sales representatives sometimes overpromise customers with regard to trips possible within the HOS rules (e.g., 10 hours driving for buses). This sometimes leads to HOS violations for their drivers. |
| **Most Important Areas of Safety Management** | In Question 31, driver selection and hiring (a), driver training and communications (b), and driver scheduling/dispatching (e) were indicated as the most important areas of safety management. The first two of these were emphasized in interview comments. |
| **Effective Safety Management Practices** | The following were indicated as effective safety practices for the company as a whole: road/range screening tests (17), driver applicant questionnaire (18), safety meetings (19), driver safe driving bonuses (20), web-based training programs (21), in-house training media (22), vehicle PMs (26), reimbursing tolls (28), tracking company safety statistics (29), and participating in peer meetings (30). Carrier J requires most of its subsidiaries to engage in these practices. Company-wide requirements include a largely standardized driver selection system. Selection includes medical qualifications reviewed by a single medical provider for consistency and rigor, and then updated annually instead of every two years as required by the Federal Motor Carrier Safety Regulations (FMCSRs). Driver applicants fill out two questionnaires, one of which is a private self-assessment that they do not turn in. The self-assessment confronts applicants with |

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| | the challenges to expect on the job so they have no delusions moving forward. All of Carrier J's buses are equipped with GPS units, which provide navigational aid to drivers and records of vehicle location and speed. Most are also equipped with DriveCam® for crash and incident documentation. |
| **Desired or Planned Enhancements** | Carrier J plans to become more systematic in its monitoring of subsidiary companies. This includes plans to have traveling auditors who visit each company for 7 to 10 days to monitor safety, environmental practices, and other aspects of company management. Carrier J is also placing more emphasis on Behavior-Based Safety (BBS), both for crash reduction and to reduce nondriving injuries. |
| **Small Carrier Advantages/ Disadvantages** | The interviewee believes that Carrier J has achieved "the best of both worlds" in its safety management. Each subsidiary deals with a smaller number of drivers and other safety factors, and thus has more direct control over them. Meanwhile, the parent company provides resources and guidance that the individual subsidiaries would not otherwise have. |
| **Other Comments/ Lessons Learned** | The interviewee believes that the safety standards it imposes on its subsidiaries consistently improves their safety. In some cases, improvements have been dramatic. Small company owners (who become general managers when companies are acquired by Carrier J) still exert a huge influence on the company's safety climate and outcomes, however. Their leadership is key. |

CHAPTER FOUR

# EVIDENCE REVIEW

This chapter presents findings relating to safety management in small motor carriers. Most information in this chapter is based on the project literature review; its methodology was described in chapter one. In addition, this chapter cites and recaps pertinent findings from the project survey of carrier managers (chapter two) and from the ten case study interviews (chapter three). Chapter topics include:

- Business, operational, and safety management in small companies
- Small company violation and crash rates
- Vehicle equipment and maintenance
- Operational planning and risk avoidance
- Driver hiring
- Driver orientation, training, and communications
- Driver supervision
- Crash and incident investigation
- Carrier performance tracking and benchmarking
- Management development
- Comprehensive safety management approaches.

## BUSINESS, OPERATIONAL, AND SAFETY MANAGEMENT IN SMALL COMPANIES

This section addresses management in small companies, including business management, operational management and supervision, and safety management. Some of the studies cited relate specifically to transportation companies, but most of this section relates to business and industrial management in general. Transportation has its own unique issues, but by and large the same management principles and practices apply across all types of businesses.

### Business Management

In a nontransportation study, Jennings and Beaver (1997) explored the competitive advantages that small firms might have over larger ones, and the pitfalls that they might face. Small firms' advantages include low overhead and the flexibility to pursue relatively small market opportunities quickly. Small company management is close to, and usually part of, the firm's operations. Employee relationships are direct and informal, allowing many problems to be resolved immediately. There is no need for accountability beyond the company's owner and customers. Jennings and Beaver define small business success as "the sustained satisfaction of principal stakeholder aspirations."

According to Jennings and Beaver, a disadvantage for small firms is the difficulty of sustaining both tactical and strategic decision making. A small company's manager has a qualitatively different job than a manager in a larger firm. He or she cannot specialize or focus narrowly on one aspect of the business. Rather, the manager must fulfill multiple roles while responding to multiple exigencies. A risk is that managers become spread too thin and are continually occupied addressing immediate demands and short-term opportunities. They may make poor business decisions or take unwise actions because they are not able to rise above the fray to think strategically. Also, there is a risk in having a single key decision maker. The lack of checks and balances means that small companies are more vulnerable to wrong decisions based on the biases or mistaken beliefs of their leaders. A successful small business manager must be versatile, multi-talented, able to oversee both the operational and business sides of the enterprise, and able to think strategically as well as tactically.

As with many other businesses, individuals starting a truck or bus transport company tend to be much more knowledgeable and proficient with regard to the *work* of the business than with regard to the business per se. Although most small carrier owners and managers are former drivers they may be relatively inexperienced in running a business (Sage Corporation and FMCSA 2009). Although a principal motivation for small business owners is making money, many are unprepared for the rigors of business and financial management (Entrepreneur Media 1999).

Once in business, carrier owners may find themselves overwhelmed with business concerns. Starting and sustaining a business involves developing a business plan, establishing legal status (e.g., sole proprietorship, partnership, corporation, and LLC), licensing (both business and operating authority), finding and maintaining a location/facility, truck and other equipment purchase or leasing, costing of services, assessing and dealing with competition, advertising, obtaining loans and other financing, record keeping, taxes, cash flow, contracts, creating a website, and many other management challenges largely unrelated to the work of transport. The typical small business owner starts as an expert worker, but must transition to become a business person and manager (Entrepreneur Media 1999).

Many potential problems may lead to small business failure. These include insufficient capital, overborrowing, poor

cash flow, inadequate tax and other financial planning, overly optimistic sales projection, saturation of the market by competition, poor access to markets (e.g., location, information, and contacts), inadequate equipment (especially advanced technologies), underpricing of services, inadequate insurance, lack of staff training and skills, and loose record keeping. Loose record keeping may extend to operational, safety, administrative, and financial data (Entrepreneur Media 1999).

FMCSA is developing New Entrant training, which includes instruction in "generic" business management practices (Sage Corporation 2009; Goettee et al. 2011). In the current research program this instruction is conducted by volunteers from SCORE, a nonprofit association providing training and mentoring to small businesses. SCORE teaches small business basics, such as how to develop a business plan, manage finances, and maintain business documentation (SCORE 2009). Business training for new entrants is not a regulatory requirement. However, competent business management appears to have a clear relation to safety and overall operational management. In a large study of 656 carriers of various sizes, Corsi et al. (2002) found that 553 carriers with satisfactory safety ratings averaged 3% in annual profits, whereas 103 others not rated satisfactory (i.e., rated conditional or unsatisfactory) averaged 4% in annual losses.

The project survey and case study interviews did not explicitly ask about company business management practices or financial status. Several interviewees did mention the challenge of keeping a small CMV transport company productive, financially viable, and safe, all at the same time. Uncertain cash flow and lack of funds were cited as key reasons for the lack of safety investments such as purchases of onboard safety technologies.

#### Operational Management and Supervision

Four "classic" functions of management in any organization are planning, organizing, leading, and controlling (Nelson and Economy 2005). These functions are further explained as follows:

- Plan: Develop organization vision, mission, and specific tactics; the "what" and the "how."
- Organize: Design and build the organization and its structure. Designate people for positions and create clarity of roles.
- Lead: Be a role model and motivate employees to achieve company goals.
- Control: Establish performance standards, measure and report progress, take corrective or preventive action, enforce accountability.

Nelson and Economy (2005) also suggest four "new" functions of management: energizing, empowering, supporting, and communicating. These functions include the following activities:

- Energize: Make things happen, praise and inspire employees.
- Empower: Give workers the tools and authority to perform well. Encourage individual responsibility and initiative, and involve employees in decision making.
- Support: Coach and counsel employees. Recognize and foster potential in each employee. Be a colleague, not just a boss.
- Communicate: Provide fast, accurate information to employees and be open to receiving information.

Management textbooks such as that by Nelson and Economy recommend various practices for successful company leadership. Many of these suggestions are directed toward increasing employee motivation and productivity, with the indirect benefit of allowing managers to spend more time on strategic planning, marketing, and innovation. For example, two common recommendations for managers are to delegate as much as possible and to foster teamwork among employees. However, the nature of CMV fleet operations may make these difficult. In businesses where employees work at one site, managers may delegate activities such as detail work, information gathering, repetitive assignments, and surrogate roles (e.g., filling in for the manager at meetings). Delegating such tasks is difficult in a transport environment where drivers are usually not physically present and their jobs are qualitatively different than the manager's. Fostering esprit de corps and common purpose among driver employees may also be a challenge. There is typically little communication among drivers, and they are each pursuing their own individual work goals rather than group goals. Establishing driver committees to address company issues or even holding regular meetings among drivers can be problematic.

What kind of personality makes for a successful chief executive? To find out, Miller and Toulouse (1986) conducted a survey study of 97 "small" firms representing many different kinds of businesses. Although the firms were characterized as "small," they had an average of 382 employees, making them much larger than the average truck or bus company. Regardless of that, the study provides insights into top executive personality types and how personality relates to management style and to success. They identified three types of executive personality types or styles, each with its own strengths and potential weaknesses. The three types were (1) *flexible personality,* (2) *high nAch* (i.e., high need for achievement), and (3) *internal locus of control.* The textbox here defines and describes the three in greater detail.

Is one of these personality types best for a small company? Although there are likely to be many exceptions, it appears that the largest number of small company leaders fit the flexible personality profile. High nAch individuals may function better in larger, established organizations. Internal locus of control (LOC) is almost always a positive characteristic for company managers and professionals in general.

***Three Chief Executive Personality Types***

(1) Flexible Personality. Someone with a *flexible personality* is informal, confident, assertive, and adventurous. CEOs with flexible personalities often lack thorough analysis in their decision making. Rather, they tend to act on intuition rather than formal investigation. They often thrive in small firms, but less often in large ones where decisions are often more complex and require thorough analysis. Companies with flexible CEOs are often informal, niche-oriented, and adaptable to various market conditions and opportunities. Responsibilities are delegated to subordinates who may become highly motivated based on their sense of personal involvement in the company.

(2) High nAch. The acronym "nAch" stands for *need for achievement.* Someone with high nAch is proactive, analytical, and driven toward specific and tangible accomplishments. CEOs with this personality type are usually successful in large firms and stable environments. They are risk-averse and use long-term planning in their decision making. Firms operating under these types of CEOs are often formal and specialized. Often these managers do not delegate well, and they may stifle initiative by their subordinates by being overcontrolling.

(3) Internal LOC. Although presented as a distinct, third manager type, this personality type does contain some elements of the first two types. A person with an internal LOC is task-oriented, adaptable, and believes that consequences, good or bad, stem directly from his or her behavior and efforts. In contrast, a person with *external* LOC may believe that outcomes "just happen" independently of their efforts. A CEO with internal LOC is proactive and decisive, but also willing to delegate. These individuals are generally "risk neutral" in their decision making and may find success in any size firm, especially in dynamic environments. Their companies tend to be informal and adaptable.

The project case study interviews did not include any personality testing, but did provide impressions of managers' styles and how their companies operated. By and large, the companies were informal, niche-oriented, and adaptable to market opportunities, and their managers appeared to best fit the "flexible personality" type.

#### Safety Management

This section presents general concepts relating to safety management in organizations. The context is not specific to motor carrier safety, although many general safety management principles apply directly to transportation. At a top level, safety management involves many of the same elements as organizational management in general. Figure 4 is a schematic illustrating the flow of the key aspects and activities of a successful health and safety management system within a company.

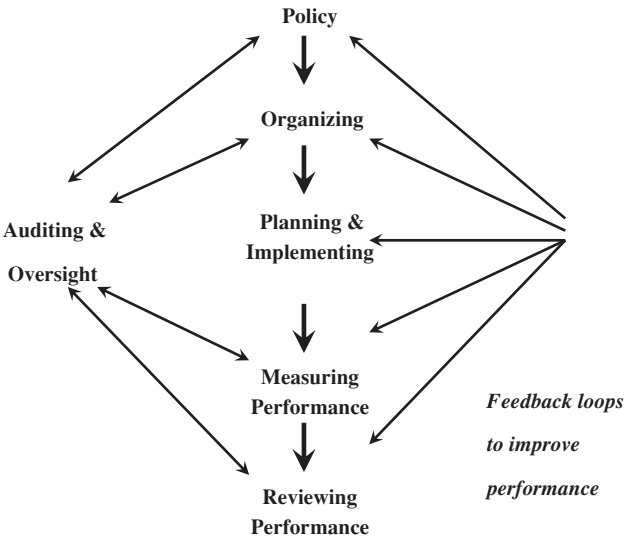


FIGURE 4 Key aspects and activities of a successful health and safety management system. Adapted from Health and Safety Executive (2008).

*OSHA Safety Management Guidelines*

The Occupational Safety and Health Administration (OSHA) is an agency of the U.S. Department of Labor responsible for occupational safety and health, generally relating to work activities other than driving. Nevertheless, much of their work relates to safety in general, including driving. OSHA has published a handbook (OSHA 2005) to help small business employers meet the legal requirements imposed by the Occupational Safety and Health Act of 1970, and to help them achieve in-compliance status in an OSHA workplace inspection. The handbook includes information about legal requirements, tips to help businesses meet these requirements, self-inspection checklists, and information on sources for assistance. The handbook encourages owners to develop a safety and health management system, which addresses four basic elements of good safety and health programs: (1) management commitment and employee involvement, (2) worksite analysis, (3) hazard prevention and control, and (4) training for employees, supervisors, and managers. The following textbox defines these four elements and provides examples.

***OSHA's Four Key Elements of Company Occupational Safety and Health Programs***

- *Management Commitment and Employee Involvement.* The manager or management team leads the way by establishing policies, assigning responsibilities, setting an example, and involving employees. Suggested examples:
  - Hold meetings with all employees to communicate your safety and health policies and objectives. Get employees involved and encourage them to help identify and resolve safety and health issues.

  - Ensure that you, your managers, and your supervisors all follow the same safety requirements that apply to employees. For instance, wear a hard hat in work areas if you require other employees to do so.

  Periodically review what you have accomplished in meeting your objectives and reevaluate whether you need new objectives or revisions to the program.
- *Worksite Analysis.* Managers continually analyze the worksite and processes to identify existing and potential hazards. Suggested examples:
  - Request a consultation visit from government officials overseeing occupational safety and health to get a full, independent survey of your operations. Contract for the same services from expert private consultants if you prefer.
  - Make sure your employees feel comfortable telling you about their safety concerns; for example, equipment or procedures that appear dangerous.
  - Review several years of accident, injury, or illness records to identify patterns that can help you devise strategies for improvement.
- *Hazard Prevention and Control.* Establish methods to reduce or otherwise control existing or potential hazards. Suggested examples:
  - Enforce the rules for safe work procedures. Ask employees to help you establish a disciplinary system that is fair and understood by everyone.
  - Provide for regular equipment maintenance and maintain records of completion.

  Establish access to medical personnel for consultation on employee health matters. Employers do not need to provide health care, but they must be prepared to deal with medical emergencies or other health problems connected to the workplace.
- *Training for Employees, Supervisors, and Managers.* Train managers, drivers, and other employees to understand and deal with worksite hazards. Suggested examples:
  - Train employees on every potential hazard that they could be exposed to and how to protect themselves. Verify that they understand it. Pay special attention to new employees.
  - Train your supervisors to understand all the hazards faced by employees and how to reinforce training and company policies.
  - Have a behavioral management plan to include positive recognition for safe performance and, if necessary, disciplinary action for misbehaviors.

*Source:* OSHA (2005).

*National Safety Council's 14 Elements*

The National Safety Council (NSC) promotes *14 Elements of a Successful Safety and Health Program.* The 14 elements listed in the textbox apply to industrial organizations and operations of all types (NSC 1998). The 14 elements may be used as a self-evaluation checklist for any organization seeking to assess its safety management program and practices. The fourth item listed ("Manage regulatory compliance") is a major requirement in motor carrier safety. Note, however, that the other 13 items listed are not primarily regulatory in nature. Rather, they involve active management that is largely "beyond compliance" (Knipling 2009). A generic element such as "Manage and control external exposures" has special relevance to CMV safety because of the large number of CMV crashes precipitated by the actions of other motorists.

**The National Safety Council's *14 Elements of a Successful Safety and Health Program***

- Recognize, evaluate, and control hazards
- Design and engineer safe workplaces
- Manage safety performance
- Manage regulatory compliance
- Address occupational health
- Collect safety-related information
- Incorporate and involve employees at all levels
- Motivate employees and positively modify their behavior and attitudes
- Train employees and orient them with new procedures and equipment
- Communicate safety-related information
- Manage and control external exposures
- Manage external environments
- Integrate safety into hiring and placement processes
- Measure the performance of safety-related activities.

All of NSC's 14 elements were evident in various interviewee statements in the chapter three case study interviews. "Manage regulatory compliance" was the most recurrent element and dominated the safety programs of some carriers. "Integrate safety into hiring" was the second most frequently mentioned element.

*Safety Culture and Climate*

"Culture" embodies a society's shared beliefs, ideals, and behavior patterns. Companies and other organizations have cultures just as larger societies do. *Safety culture* refers to the shared values and beliefs within an organization that establish safety as a priority and drive organizational policies and practices. Safety culture is embodied in company priorities, rules, management practices, worker behaviors, employee attitudes, and the safety record of the organization. As stated by Glendon and Stanton (2000), safety culture is "fundamental to an organization's ability to manage safety-related aspects of its operations."

In *CTBSSP Synthesis 14,* Short et al. (2007) examined the role of safety culture in motor carrier safety. The report examined different concepts, aspects, and indicators of safety culture, and found it was reflected in the attitudes of both managers and drivers within a company. Stability of a company's labor pool, careful analysis of safety problems, and strong safety communication across the company were among

the key indicators. The synthesis offered a sequence of the general steps a company may take to enhance its safety culture, change specific practices, and attain crash reduction goals.

*Safety climate* is similar to safety culture. Although culture embodies values, beliefs, and underlying assumptions, climate is "a descriptive measure reflecting the workforce's perceptions of the organizational atmosphere" (Flin et al. 2000). Broadly, safety climate is a "snapshot" of the established condition of safety of an organization at a given point in time. Any distinctions between "safety culture" and "safety climate" are far less important than the practices and outcomes associated with them.

Safety climate is best measured by "leading indicators" of safety activity and performance. In the past two decades, there has been decreased reliance on "lagging" measures of safety such as retrospective statistics on crashes and violations. Current emphasis is on using "leading" or predictive assessments of safety climate within organizations (Flin et al. 2000). This shift is driven by the conclusion that organizational, managerial, and human factors, rather than technical failures, are the prime causes of accidents in industry. By looking at a company's processes and practices, rather than merely its bottom-line crash or incident statistics, its safety climate can be better assessed. When researchers and safety consultants seek to effectively assess the safety climate of a company, they look at management areas and practices such as the following (Flin et al. 2000):

- Management
  - Attitudes and behavior toward safety (especially among first-line supervisors)
  - Attitudes and behavior toward production
  - Employee selection
  - Discipline.
- Safety system
  - Safety policies
  - Assigned responsibilities and areas of control
  - Safety committees with worker involvement
  - Safety equipment.
- Risk
  - Explicit recognition and perception of risk factors or hazards
  - Amount of self-reported risk taking.
- Control of work pressure
  - Reasonable individual workloads
  - Reasonable work pace
  - Realistic expectations.
- Competence
  - Worker knowledge and skill
  - Worker qualifications
  - High selection standards.

Flin et al. (2000) regard the most significant measures of safety climate to be management attitudes and behaviors in relation to safety. Positive management attitudes lead to other positive practices such as clear safety policies and systematic employee selection and training. The researchers emphasize the importance of first-line supervisors in setting a good work atmosphere and thus a good safety climate for a company's operations. The impact of the supervisor on safety management has been realized for many decades. "The supervisor . . . is the key [person] in industrial accident prevention. His application of the art of supervision to the control of worker performance is the factor of greatest influence in successful accident prevention" (Heinrich 1959, quoted in Flin et al. 2000).

Different dimensions of safety climate are related to work-related driving and occupational incidents. Wills et al. (2006) measured six different safety climate factors and four aspects of self-reported occupational driving. All of the safety climate factors were correlated with self-reported driving incidents, but some had more significant associations. Table 13 summarizes the relationships. The large X's in Table 13 represent the safety climate factors that were the most significant predictors

TABLE 13
SUMMARY OF SIGNIFICANT SAFETY CLIMATE FACTOR PREDICTORS

| Safety Climate Factor | Good Overall Driver Behavior | Reduced Driving Distraction | Reduced Traffic Violations | Reduced Driver Error | Pre-Trip Maintenance |
|---|---|---|---|---|---|
| Open Communication | x | **X** | x | **X** | **X** |
| Low Work Pressures | x | **X** | x | x | x |
| Strong Relationships | x | x | x | x | x |
| Clear Safety Rules | **X** | **X** | **X** | **X** | x |
| Effective Driver Training | x | **X** | x | x | x |
| Management Commitment | x | **X** | x | **X** | x |

*Source*: Based on Wills et al. (2006).

of occupational safety for drivers in the study. However, all cells of the table contain x's, indicative of the authors' view that all of these factors and behavioral indicators were interrelated.

Safety climate is commonly cited as a predictor of injury occurrence. In a survey of 2,680 employees of 18 large companies in multiple industrial sectors, Huang et al. (2006) identified the following indicators of a positive safety climate:

- Management strongly committed to safety
- Fair return-to-work policies
- Reasonable post-injury administration policies
- Effective safety training
- Worker sense of safety control (i.e., workers feel knowledgeable about safety and are able to exercise control over their own safety).

Huang et al. found these characteristics to be inversely associated with worker injuries. These company characteristics were also positively associated with each other. Worker sense of safety control appeared to be a critical bridge between company practices and outcomes. Safety outcomes were best when workers were knowledgeable about risks and correct practices, and were empowered to act on that knowledge.

Findings from DeJoy et al. (2004) reinforce these conclusions. They found that companies with the best safety climate: (1) were generally well-run and had effective general management policies and procedures in place, apart from safety; (2) had clear safety policies and programs in place; and (3) reduced specific hazardous conditions associated with the work. They concluded that "A positive safety climate is more likely to exist in an environment that generally supports and values its employees and where there is open and effective exchange of information."

## SMALL CARRIER VIOLATION AND CRASH RATES

This section reviews available data on the roadside violation, moving violation, and crash rates of motor carriers of different sizes. It provides recent federal data and reviews published studies. Overall, statistics suggest that smaller carriers tend to have higher roadside inspection violation rates, and that they may also have higher moving violation and crash rates. However, there are important caveats attached to almost all of the statistics and studies cited in this section. Concerns about methodology are cited in the context of each study. By and large, the findings cited in this section are not definitive owing to methodological concerns.

### Roadside Inspection Data

Average out-of-service (OOS) rates in roadside inspections vary inversely with carrier size. This is true both for driver and vehicle OOS rates. Figure 5 shows this for 2006–2009 based on an FMCSA retrieval of MCMIS data. Both driver and vehicle OOS rates for carriers in the 2–19 vehicle carrier size category are more than 50% higher than those for carriers in the 100+ vehicle category. However, there is a very important caveat attached to these and almost all MCMIS roadside inspection statistics, which is that roadside inspections are not random samples of passing trucks. Rather, the Inspection Selection System has been designed to primarily target carriers with poor safety performance based on SafeStat and now CSA. The size and consistency of the OOS rate differences by carrier size suggest true underlying differences in compliance, although the magnitudes of such differences may be affected by the nonrandomness of inspection selection.

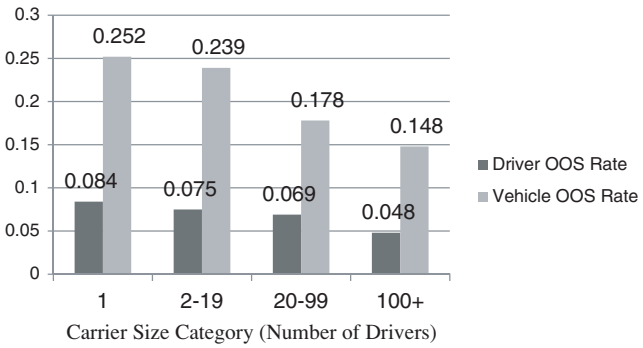


FIGURE 5 Roadside inspection out-of-service (OOS) rates by carrier size category. Combined 2006–2009 data based on 9/24/2010 MCMIS snapshot. Number of carriers represented: 9,982 (1), 22,408 (2–19), 3,687 (20–99), 719 (100+). Data retrievals conducted and provided by FMCSA.

As part of the *I-95 Corridor Coalition Field Operational Test 10,* Stock (2001) looked at 13 different measures of regulatory compliance based on roadside inspections. Statistics, broken down by seven carrier size categories, were based on U.S.DOT MCMIS statistics for an unspecified period. The 13 compliance measures were total OOS rate, vehicle OOS rate, driver OOS rate, average total violations per inspection, average number of vehicle violations, average brake violations, average steering component violations, average wheel violations, average total driver violations, average driver qualifications violations, average medical certification violations, average HOS violations, and average log violations. Without exception, each of the 13 measures showed clear relations to carrier size, with smaller carriers performing more poorly. Figure 6 shows total, vehicle, and driver OOS rates by carrier size. Overall, OOS rates for the smallest fleets were approximately 25% higher than those for the largest fleets. Figure 7 shows the average total number of violations, average number of vehicle violations, and average number of driver violations per inspection. The average total number of violations was approximately 50% higher for the smallest fleets than for the largest fleets.

As with the Figure 5 statistics, these roadside inspection statistics are not based on random samples. Instead, inspections

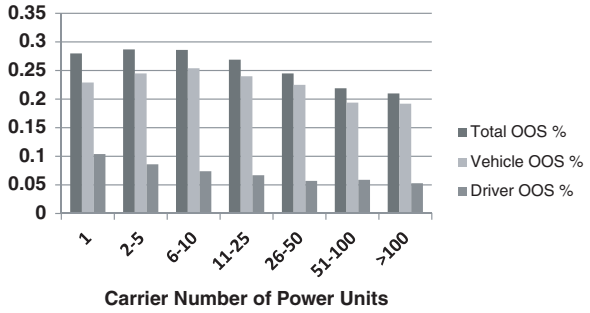


FIGURE 6 Total, vehicle, and driver OOS percentages by carrier size from Stock (2001).

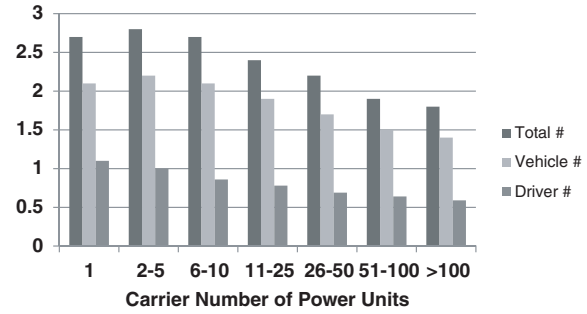


FIGURE 7 Average total, vehicle, and driver violations per inspection by carrier size from Stock (2001).

for carriers of all sizes were targeted toward those with previous violations and other risk indicators. Moses and Savage (1996) reported that a much larger percentage of smaller firms than larger firms are assigned negative safety ratings, which in turn means that a larger percentage of them are stopped at roadside. Although this small–large firm difference probably reflects true differences in risk, it could also contribute to confounding of inspection violation comparisons. The reliability of carrier safety measurements is inherently related to carrier size and the number of carrier safety observations (e.g., inspections). Even with true safety performance held constant, fewer safety observations would mean greater dispersion resulting from chance and thus more extreme values. In a recent report, the GAO (2011) noted that a large majority of small carriers have insufficient compliance data to be reliably ranked under the CSA SMS.

### Published Survey Statistics

In a large 1997 survey of company drivers (excluding owner–operators), Monaco and Williams (2000) found a relationship between firm size and safety indicators. Drivers were interviewed and asked whether they had been involved in a crash, had a moving violation, and had a logbook violation in the previous 12 months. Driver companies were classified by size and operational characteristics. Driver demographics and education were also examined. As shown in Table 14, the effects of firm size were most apparent at the high end. That is, drivers for very large companies had significantly lower rates than those with medium-sized or small companies. Unrelated to firm size, the study found that drivers under pressure to drive more hours and longer distances were also more likely to have logbook violations. There are several caveats regarding this study. Its data are based on interviews, which are inherently subject to error both from inaccurate memory and possible lack of candor. The data are also more than a decade old and not controlled for driver mileage exposure. In addition, they are time-based rather than mileage-based. Driver percentage involvement in crashes and violations over a time period varies directly with their mileage exposure for that time period. If drivers from smaller companies tended to drive more miles, it would give them higher time-based likelihoods even if their mileage-based involvement rates were the same or similar to drivers from larger companies.

In the survey portion of the *I-95 Corridor Coalition Field Operational Test 10,* Stock (2001) assessed carrier attitudes and knowledge about regulatory compliance and enforcement. Figure 8 shows comparative responses for two truck company categories: those with 11–24 trucks and those with more than 100 trucks. Carrier attitudes about the compliance system were generally positive; favorable views were more common than negative views for all carrier sizes. However, smaller carrier respondents were more likely to have negative views and were also generally less familiar with the enforcement system. This study is significantly out of date; federal enforcement systems and practices have dramatically

TABLE 14
FIRM SIZE AND DRIVER CRASH AND VIOLATION INVOLVEMENT IN THE PAST YEAR

| Firm Size | % with Crashes | % with Moving Violations | % with Logbook Violations |
|---|---|---|---|
| 25 or fewer employees | 18.8 | 40.4 | 54.5 |
| 25 to 99 employees | 20.8 | 34.1 | 55.7 |
| 100 to 249 employees | 16.2 | 24.7 | 61.7 |
| 250 to 499 employees | 15.1 | 31.4 | 59.5 |
| 500 to 999 employees | 8.0 | 12.9 | 68.2 |
| 1,000 to 4,999 employees | 5.5 | 21.8 | 37.6 |
| 5,000 or more employees | 11.1 | 12.3 | 27.6 |

From Monaco and Williams (2000).

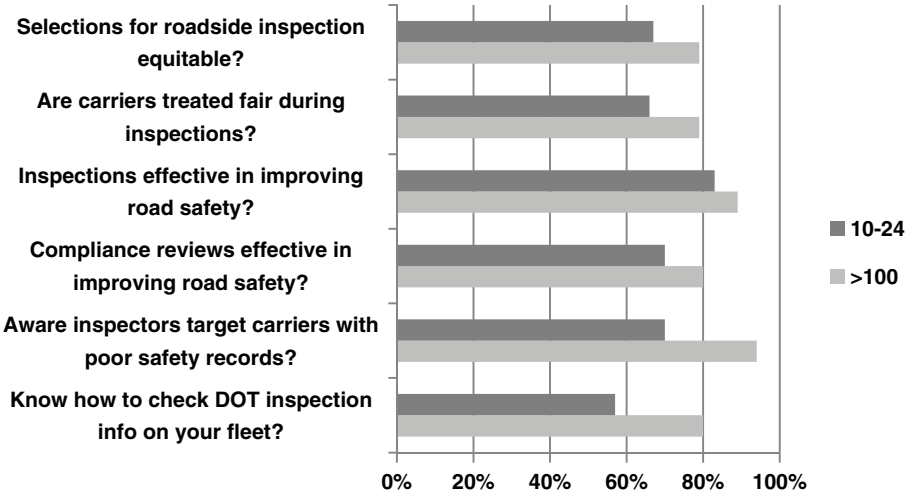


FIGURE 8 Carrier respondent compliance-related attitudes and knowledge from Stock (2001). Respondents compared are from carriers with 10–24 and >100 trucks, respectively.

changed over the past decade. Nevertheless, the findings are probably directionally accurate in relation to the situation today.

### Compliance Review Comparisons

In a review of both alternative and traditional motor carrier regulatory compliance schemes, Murray et al. (2011) compared the effects of government Compliance Reviews (CRs) on safety outcomes for carriers of different sizes. Within the traditional enforcement framework (especially before CSA implementation), CRs were on-site safety audits, which assessed HOS compliance, driver qualifications and licensing, drug and alcohol testing, and vehicle inspection and maintenance procedures. CR statistics for a five-year period from June 30, 2003, through June 30, 2008, were compared for four carrier size categories: 1–49, 50–249, 250–999, and 1,000+ power units. The percent distribution of carrier ratings following a CR was related to carrier size; that is, smaller carriers were more likely to receive an "Unsatisfactory" rating and less likely to receive a "Satisfactory" rating. Moreover, within each of the three carrier rating categories (Satisfactory, Conditional, Unsatisfactory), small carriers consistently had higher driver and vehicle OOS rates than larger carriers. They also had a higher average number of crashes per power unit. The study did not control for mileage exposure or generate crash rates for vehicle-miles traveled. Although these findings for CR fleets cast small carriers in a negative light, they should not be taken to represent the full population of motor carriers. Because all carriers in the study had received CRs, the sample was by definition skewed toward carriers with poorer safety records.

The study also compared 12-month pre- and post-CR crash likelihoods (per power unit) for carriers of different sizes. Table 15 reproduces their results for 2004. The results for the next four years (2005–2008) were similar. One sees that smaller carriers generally had higher crash likelihoods both pre- and post-CR. In part, this could reflect the concept that safety performance variability is inherently greater in small carriers owing to the greater role played by chance in their safety outcomes. The most dramatic carrier size difference, however, was in the effect of the CR. Small carrier crash likelihoods decreased by nearly one-half in the year following a CR, whereas large carrier crash likelihoods decreased by only about 5%. These results could be interpreted as suggesting that small carriers are more affected by CRs. For example, they may feel more threatened by CRs, or

TABLE 15
2004 PRE- AND POST-CR AVERAGE CRASH LIKELIHOODS

| Number of Pre-CR Power Units (PUs) | Number of CR Carriers | Pre-CR Crash Likelihood (per 100 PUs) | Post-CR Crash Likelihood (per 100 PUs) | % Change in Crash Likelihood |
|---|---|---|---|---|
| 1–5 | 3,213 | 11.3 | 5.7 | –49.6 |
| 6–20 | 2,182 | 7.8 | 5.3 | –31.5 |
| 21–100 | 1,150 | 6.8 | 5.8 | –14.8 |
| 101–250 | 177 | 4.8 | 4.4 | –9.1 |
| 251–1,000 | 79 | 4.3 | 4.1 | –5.4 |
| 1,001+ | 16 | 4.4 | 4.2 | –4.9 |

*Source*: Murray et al. (2011).

their small size may enable them to improve their safety practices more quickly and dramatically following a CR.

An alternative explanation for the pre- versus post-CR differences, however, is that the effect reflects, at least in part, a statistical artifact called regression to the mean. In statistics, regression toward the mean is the phenomenon that, if a variable is extreme on its first measurement, it will tend to be closer to the average on its second measurement (Everitt 2002). Regression to the mean is greatest when measurement-to-measurement correlations are lowest. This would be the case for year-to-year crash likelihoods for smaller carriers, because their crashes are fewer and thus inherently more subject to larger random variations. Larger carrier crash likelihoods vary less year-to-year because they tend to "average out" more each year. Because the study contained no control groups (i.e., carriers "deserving" CRs but randomly selected to not receive one), it is impossible to rule out regression to the mean as an alternative explanation for the observed stronger CR effects for smaller carriers in this study.

The DOT Volpe Center published a Compliance Review Effectiveness Model with similar findings (Volpe National Transportation Systems Center 2008). It used a comparison group of *all* carriers not receiving a CR to control for global year-to-year changes in crash likelihood, but like the vehicle-miles traveled study did not use a control group consisting of carriers meeting safety performance criteria for receiving a CR but not actually receiving one.

## VEHICLE EQUIPMENT AND MAINTENANCE

### Onboard Safety Technologies

Numerous vehicle-based technologies are applicable to large truck safety and especially to the safety of long-haul trucks, which are usually tractor–semitrailers. The textbox lists various safety technologies available for installation on large trucks. Tractor–semitrailers are in many ways the ideal platform for the use of advanced crash avoidance technologies. Although their crash rates per mile traveled are the lowest of major vehicle types, their high mileage exposures (5–10 times the average car) and high severity of their crashes (on average approximately twice that of cars) make them inherently high-risk vehicles (Wang et al. 1999; Knipling 2009). Zaloshnja and Miller (2007) calculated the average comprehensive cost of a police-reported crash involving a large truck to be $91,112 in 2005 dollars. This included direct economic loss plus a monetary valuation of pain and suffering and quality-of-life lost. In spite of tractor–semitrailers' generally low crash rate per vehicle-miles traveled, the combination of their high mileage exposures and high severities of crashes that occur drive up their average life-cycle crash costs to levels far above those of other vehicles. One direct comparison (Wang et al. 1999) found tractor–semitrailer per-vehicle life-cycle costs (all crashes regardless of fault and inclusive of all crash consequences) to be approximately five times those of straight trucks, light trucks/vans, passenger cars, and motorcycles.

**Truck Vehicle-Based Safety Technologies**

- Improved Brakes (e.g., air disc brakes)
- Electronic Stability Control
- Roll Stability Control
- Forward Collision Warning Systems
- Side-Object Detection Systems
- Backing Collision Warning Systems
- Lane Departure Warning Systems
- Onboard Safety Monitoring
- Driver Alertness Monitoring
- EOBRs
- Electronic Data Recorders
- Vehicle Condition Monitoring (e.g., tire pressure monitoring systems)
- Automated Transmissions
- Speed Limiters
- Truck-Specific Navigation Aids
- Enhanced Trailer Conspicuity
- Enhanced Trailer Rear Lighting/Warnings
- Video Mirrors.

*Source:* Knipling and Hyten (2010).

High average life-cycle crash costs mean that tractor–semitrailers, among all major vehicle types, are generally the best platform for cost-effective applications of vehicle-based safety technologies. A safety device installed on a truck tractor at the time of purchase will generally perform for the life of the vehicle and have far greater opportunities to prevent a serious crash than the same device installed on a car, short-haul truck, or other low mileage vehicle. Moreover, approximately two-thirds of all human and material harm in large truck crashes is outside the truck (i.e., to other motorists), so there is high potential for large liability claims against truck drivers and their companies. A company that can afford to equip its vehicles with proven safety technologies is likely to reap positive returns-on-investments (ROIs) over time. Table 16 shows estimated median ROIs and median payback periods for fleets adopting three of the better-known, vehicle-based crash avoidance devices (FMCSA 2009).

The previous discussion suggests that all CMV transport companies consider equipping their vehicles with crash avoidance technologies, and that they would profit from the investment. Unfortunately, there are economic obstacles to greater deployment of truck safety technologies (Houser et al. 2007; Knipling 2010). Large, successful companies may have sufficient capital and cash flow to finance purchases of vehicle safety technologies. But that is not true of most companies, and especially smaller companies, where tight profit margins are the rule. In addition, larger companies are more likely to be able to negotiate price reductions based

TABLE 16
ESTIMATED BENEFIT-COSTS OF THREE LARGE TRUCK SAFETY TECHNOLOGIES

| Vehicle-Based Safety Technology | Median ROI per $1.00 Investment | Median Payback Period |
|---|---|---|
| Forward Collision Warning | $4.28 | 23 Months |
| Lane Departure Warning | $3.96 | 23 Months |
| Roll Stability Control | $5.51 | 18 Months |

*Source*: FMCSA (2009).

on volume purchases, and are more likely to have technicians on payroll who can support system use. A recent *Transport Topics* article by Johnson (2011) noted the problems small companies have keeping their equipment current. The article quoted Andy Ahern of Ahern and Associates, a consulting firm, to the affect that "The small guys are having a hard time. They're not getting paid on time, they're not getting the financing to buy equipment and many of them cannot get their rates up."

Vehicle safety equipment was addressed by several survey questions. Question 23 asked about EOBR use. Only 16 of 110 respondents reported using EOBRs on their vehicles. Those using them gave them a high average effectiveness rating of 3.4 on the 0–4 Likert scale. Question 25 asked respondents if they "Purchase[d] advanced vehicle safety systems (forward collision warning, lane departure warning, electronic stability control, onboard computers to monitor driving, etc.)." Only 4 of 111 respondents answered yes. In Question 31 on the most important areas of safety management, the choice "vehicle safety equipment (e.g., technologies such as collision avoidance systems)" received the fewest votes of the ten areas presented.

The following are survey comments relating to vehicle safety equipment:

- Vehicle safety equipment is more often than not too costly for small carriers to obtain in today's economy.
- The continual adding of expensive [equipment and] cost to new motorcoaches is pricing a new coach at an impossible level for many small companies. Thus, older vehicles will be used much longer.
- We would love to try EOBR's, but do not have the budget. Funding these safety advances will be critical to smaller operators.

Few of the case study interviewees expressed an active interest in vehicle safety technologies. Carrier C, which hauls large 8-axle trailers, expressed an interest in trailer disc brakes for improved performance. Tire Pressure Monitoring Systems were also mentioned in interviews. Some carriers considered these technologies to be a "wish list" item, but cash flow problems eliminated them from serious consideration. More often, safety technologies were not mentioned by interviewees.

### Vehicle Maintenance Practices

Proper vehicle maintenance is an essential legal requirement for CMV safety, and most carriers regard vehicle maintenance as their most fundamental safety activity (Knipling et al. 2003). Both federal and state governments have extensive vehicle regulations and enforcement programs targeting brakes, tires, lights, and other vehicle components with potential deficiencies. Mechanical failures are rare as a direct cause of crashes when compared with human causes, but they are still considerable. In the Large Truck Crash Causation Study (LTCCS), 10% of truck at-fault involvements (5.5% of all truck crash involvements) were attributed to a vehicle-related Critical Reason (proximal cause). Types of failures included brake deficiencies, cargo shifts, tire/wheel failures, and suspension failures. The presence of a vehicle problem as an associated factor (even when not necessarily a cause) was strongly correlated to crash fault (i.e., Critical Reason assignment). Associated vehicle factors were noted in 62% of truck single-vehicle crashes, 50% of truck at-fault multi-vehicle crashes, but only 21% of truck not-at-fault multi-vehicle crashes (Knipling 2009). The nature of the vehicle deficiency can be associated with crash type. Blower (2009) reported that brake OOS violations were more common in LTCCS crashes where the truck was the striking vehicle, whereas lighting OOS violations were more common when the truck was the struck vehicle. Vehicle maintenance is one of the seven CSA BASICs. Earlier in this chapter it was noted that small carrier vehicle OOS rates in inspections are greater than 20%, with the important caveat that these inspections target poor-performing carriers and thus are not random samples.

Motor carriers of all sizes consider vehicle maintenance to be a priority safety management activity. Regular practices include pre- and post-trip inspections, annual vehicle inspections, PM, and repairs. Small companies perform many maintenance tasks themselves, although some do not have facilities for major repairs. In *CTBSSP Synthesis 1* (Knipling et al. 2003), respondents were asked to rate and rank 28 carrier safety management practices for their importance. "Regularly scheduled vehicle inspection and maintenance" received the highest mean rating of all 28 practices. In a survey of 148 safe carriers, Corsi and Barnard (2003) found that 76% agreed or strongly agreed with the statement, "Cost is no issue when it comes to keeping our vehicles defect free."

About 80% agreed that, "Deploying a defect-free fleet is the most important thing we can do to ensure highway safety."

More and more companies are using maintenance management software to facilitate regular maintenance and scheduling. In 2003, Corsi and Barnard found that 56% of their "safe carrier" respondents used such programs. Percentages varied by fleet size; that is, 78% for large fleets versus 23% for small fleets. Perhaps because they used such programs, large carriers also tended to perform routine inspection and maintenance tasks (e.g., brake servicing) more often than smaller fleets.

A review of maintenance management software websites (Knipling et al. 2011) reveals numerous ways that truck maintenance software can assist fleets. They help fleets and other truck maintainers to better manage PM schedules and tasks, parts inventory, fuel and tire use, and other maintenance-related needs. Software vendors claim that they reduce costs, improve productivity, increase warranty recoveries, improve auditing and billing, provide documentation of maintenance actions (that may be critical in enforcement and liability cases), and generally make equipment maintenance more systematic. However, their more sophisticated features (e.g., generating maintenance-related bar codes for vehicle parts) are probably beyond the needs of most small fleets.

Survey Question 15 asked respondents to indicate the two most challenging CSA BASICs, and Question 16 asked for the two least challenging. Vehicle maintenance was rated as the third most challenging of the CSA BASICs. Survey Question 26 asked respondents if they maintained PM schedules and records for each vehicle. Overwhelmingly (109 of 112) respondents reported they did, and the practice received a high effectiveness rating of 3.2 on the 0–4 Likert scale. In Question 31 on the most important areas of safety management, the choice "vehicle PM" was rated second, behind only driver selection and hiring. In survey comments, one respondent said, "Most owner operators and small fleet operators do a good job of maintenance and safety but are lacking in the back up aspects such as paper work. I know owner operators that do their own maintenance work but don't keep very good records."

In the project interviews, approximately half of the small carriers interviewed indicated that vehicle maintenance was their single biggest safety activity and concern. Cargo securement was also a major concern, especially for flatbed operators, but for others as well. Vehicle maintenance was strongly driven by the FMCSRs and the threat of violations, especially under CSA. The smallest carrier interviewed, Carrier A, reported that its day-to-day safety practices were far more frequently related to vehicle maintenance and cargo securement than to driver issues. Regarding vehicle problems, if there is "anything DOT [regulation-related], it doesn't go down the road." Carrier C runs high-productivity, double-trailer rigs with 42 tires and 20 brakes; it must be "obsessive" about vehicle maintenance.

Although the case study interviewees affirmed the importance of vehicle maintenance, they also complained about roadside vehicle inspections. Most often the complaints were about lack of consistency in vehicle-related violation criteria. Specific comments related to "gray areas" in vehicle component and cargo securement inspections.

### OPERATIONAL PLANNING AND RISK AVOIDANCE

*CTBSSP Synthesis Report 21* (Knipling et al. 2011) explored carrier operational efficiencies that may also provide safety benefits by decreasing exposure to risk. The report made a distinction between *risk reduction* and *risk avoidance* strategies in CMV transport. Risk reduction encompasses most CMV safety management practices and interventions such as vehicle maintenance and various efforts to improve drivers. Risk avoidance strategies are those where carriers plan and conduct their operations in ways that minimize exposure to crash risk. A good example is route planning prior to trips. Routes that maximize travel on Interstates and avoid urban traffic are not only efficient, they are far safer as well. They *avoid* risk. Other carrier risk avoidance strategies include reducing empty ("deadhead") trips, minimizing loading and unloading and related delays, avoiding work zones, optimizing travel times, use of higher productivity vehicles, and team driving.

Risk avoidance can be represented schematically. Figure 9 shows a simple timeline of crash risk, cause, and occurrence. Both crash risk factors and causes may be human, vehicle, or environmental. The extended risk timeline on the left side is intended to show that pre-trip and pre-crash-threat decisions can reduce crash risk well before imminent crash threats are encountered. Pre-trip practices affecting risk include trip scheduling to avoid high-traffic times and driver fatigue. Once on the road, pre-crash threat avoidance includes route selection to eschew undivided highways, traffic congestion, and work zones. The dotted lines between the risk zones denote that many risk avoidance practices are operating across the zones.

Loading and unloading delays are pre-trip events that *raise* crash risk before a trip even begins. These delays usually increase driver fatigue, driver frustration, and trip schedule pressure. *CTBSSP Synthesis 21* (Knipling et al. 2011) noted that smaller carriers are more vulnerable to both trip delays and schedule pressure by shippers because they do not have the economic leverage and wherewithal to assert carrier interests and, if necessary, walk away from a shipper account. A recent report by the U.S. General Accountability Office (GAO 2011) addresses the issue of commercial driver detention times. GAO's summary findings included:

- Detention of drivers at shipper or receiver facilities is a prevalent problem—of 302 drivers interviewed by GAO, 204 (68%) reported being detained within the past month.

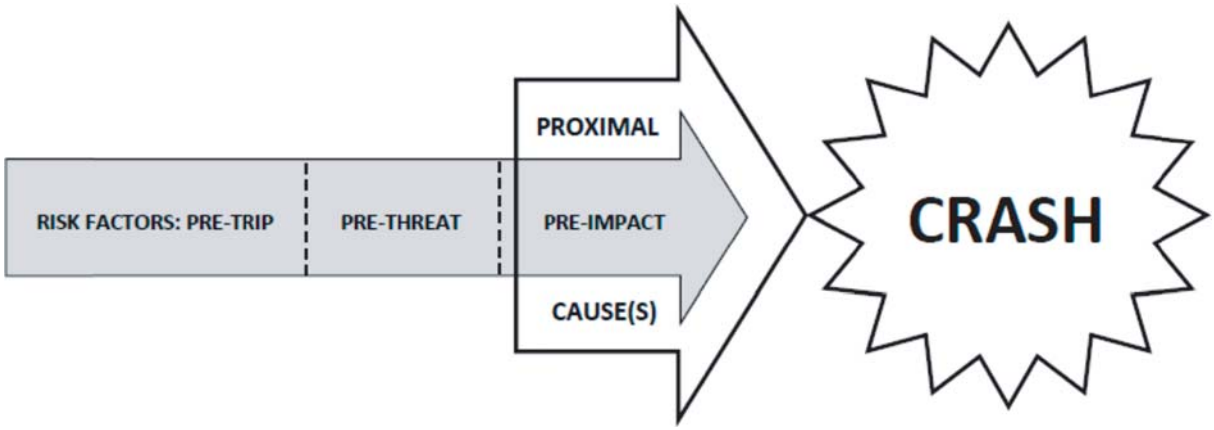


FIGURE 9 Risk-cause crash timeline with extended pre-crash risk segments. Reproduced from Knipling et al. (2011).

- Of those drivers who had experienced detention, 80% stated that it affected their ability to meet HOS requirements, and 65% reported losing revenue as a result of being detained.
- Shippers and receivers control many of the factors leading to driver detention, such as facility staffing, loading and unloading equipment, quality and promptness of service, and the readiness of products for pick up.
- Shippers often disagree with carriers and drivers about the amount of detention time and its causes.
- Carriers have some ability to mitigate the problem by charging detention fees to shippers, developing better working relationships with customers, improving communications, and abandoning shipper accounts where detention is a problem.
- Larger carriers have greater resources and more leverage with clients than smaller carriers and thus are generally able to mitigate the problem more effectively.

Drivers and carriers know that delay costs them money; however, it appears that they do not fully appreciate the cost. A recent analysis by Texas Transportation Institute (Miao et al. 2011) used a mathematical simulation model to estimate travel delay costs to tractor–semitrailer drivers and their carriers. They estimated the cost at $80 to $121 per hour, depending on conditions and assumptions in their model. Concurrently, they conducted a survey of drivers and carriers, asking them to estimate the cost to them of travel delays. Their mean estimates were in the $26 to $68 per hour range. The authors concluded that the many in the trucking industry do not fully realize the costs they incur owing to travel delays. Drivers paid by the mile perceived the cost to be higher, but it was still below actual costs, as estimated by the study. This study focused on roadway (e.g., traffic) delays, but its results apply to loading and unloading delays as well.

Reimbursing toll charges to drivers is a way to reduce operational risks caused by "diversion." Diversion occurs when truck drivers (or other motorists) choose not to drive on toll roads in order to avoid paying those tolls (Short 2006). They are likely to instead choose a parallel undivided highway with far greater crash risks. Undivided highways have crash risks that are higher than those of toll roads "by at least a factor of 3 or 4 . . ." (Harwood 2006).

The problem of loading and unloading was the primary operational planning issue addressed explicitly in the project questionnaire. Question 10 asked respondents to rate the safety importance of "Delays associated with loading and unloading cargo." For truck respondents, this safety problem received a mean importance rating of 2.9 on the 0–4 Likert scale, placing it in the top half of the items. This was not an important issue for bus respondents.

In the survey section on operational practices, Question 27 asked respondents if they charged detention fees for loading and unloading delays. Among truck respondents, 62 of 79 respondents charged them, and the practice received an average effectiveness rating of 2.5 on the 0–4 scale. On Question 28, 98 of 111 respondents indicated that they reimburse toll charges to drivers or provide "EZ Pass" transponders. The practice was rated 2.8 on the 0–4 Likert scale for effectiveness.

In Question 31 on the most important areas of safety management, three of the ten items presented might fall (fully or partially) under operational planning and risk avoidance:

- Item (e), driver scheduling and dispatching practices was rated 4th in importance.
- Item (f), trip planning, routing, and navigation was rated 6th in importance.
- Item (g), loading, cargo securement, unloading, and dock/yard practices was rated 9th in importance.

Loading and unloading delays were discussed in almost all of the truck case study interviews. In general, managers were frustrated by them and believed that small carrier efforts to reduce them were not always effective. Even when shippers or receivers paid detention fees, excessive delays disrupt carriers' operations and the drivers' personal schedules.

Another possible risk avoidance strategy was employed by Carrier C, which operates in a U.S. state permitting 8-axle "B-Train" trailer combinations with more than twice the cargo capacity of conventional single trailers. In this case, risk avoidance would be achieved by increasing driver and vehicle productivity without corresponding increases in crash severity or frequency.

Otherwise, interviewees did not mention the kind of risk avoidance issues discussed in *CTBSSP Synthesis 21* or represented schematically in Figure 9. To some extent, small carriers may "not see the forest for the trees" with regard to operational efficiencies that may also decrease crash risks. Also, although small carriers often have a high level of flexibility to respond to customer demands, they do not have enough drivers and vehicles to employ different deployment strategies that might avoid risk.

## DRIVER HIRING

Most of management is Human Resource Management (HRM). One may speak of "cradle-to-grave" HRM incorporating employee recruiting, selection, hiring, orientation, training, supervision, evaluation, retention, and termination. This section addresses driver hiring (including recruiting, selection, and initial hiring) and the next two sections address other HRM stages.

### Importance of Driver Selection

Numerous studies have revealed large and persistent individual differences in driver crash risk (Knipling et al. 2004). For example, in one naturalistic driving (instrumented vehicle) study of commercial drivers (Hickman et al. 2005), 95 drivers were rank-ordered by their rate of involvement in at-fault road incidents. The worst drivers, with just 19% of total exposure, accounted for 53% of all at-fault events. The rest of the drivers had 81% of the exposure, but just 47% of the risk. For carriers of all sizes there is a safety premium on selecting good drivers for employment. As stated in the ATA Foundation publication *SafeReturns* (ATAF 1999b), "starting with the right people is key to overall safety performance."

*CTBSSP Synthesis 21* (Knipling et al. 2011) reviewed driver selection methods in carriers of all sizes. Systematic driver selection involves assessment of various safety-relevant driver traits, such as personality, attitudes, psychomotor performance, medical status and conditions, behavioral history (particularly driving history), and mental abilities. Specific selection procedures and tests described are generally those designed to target one of these areas or, often, a more specific dimension within one of these areas.

*CTBSSP Synthesis 21* included a survey of both carrier safety managers and other experts in motor carrier safety. One question presented respondents with five different areas of safety management and asked them to select two of the five they considered most important in determining safety outcomes. The five choices were as follows:

1. Driver preparation—pre-hire CMV driving training and testing; for example, basic school training and CDL testing.
2. Driver selection and hiring—company driver recruiting, screening, selection, and hiring (includes both mandatory and voluntary hiring practices).
3. Company communications to drivers—driver orientation, finishing, safety meetings, refresher training, policy announcements, and safety reminders.
4. Driver evaluation—company monitoring and evaluation of individual drivers; for example, violation and incident tracking, ride-alongs, covert observations of driving, and onboard computer monitoring.
5. Company rewards and discipline—for example, incentives, feedback, recognition, letters (both commendations and reprimands), bonuses, pay increases/decreases, and other consequences imposed by management.

Figure 10 presents the proportion selecting each choice. Safety manager and other expert response profiles were quite similar. Within both groups, driver selection received the second highest number of votes behind driver evaluation. Both driver selection and evaluation may be considered *assessment* activities, whereas the other three choices, all receiving fewer votes, may be considered interventions to *change behavior*. These results suggest that many respondents considered driver characteristics to be relatively enduring and resistant to change. Therefore, it is critical to assess driver safety-relevant characteristics accurately.

### Driver Selection Methods

FMCSRs require carriers to perform certain actions in hiring commercial drivers. According to 49 CFR Section 391.51 and as summarized in FMCSA (2008), carriers must ensure that any driver hired meets federal minimum qualifications. To document this, carriers must maintain a qualification file for each employee with the following information:

- Driver's application for employment (completed and signed).
- Driver's MVR of past crashes and violations from the applicable state agency for the preceding 3 years.
- Driver's road test certificate or the equivalent. A current CDL is evidence of road test completion.
- Annual review of driving record based on state agency inquiry and carrier review. Certification that driver meets minimum requirements is signed by the carrier.
- Annual driver's certification of violations.
- Medical examiner's certificate.
- Record of inquiry(ies) to previous employer(s) for past 3 years.

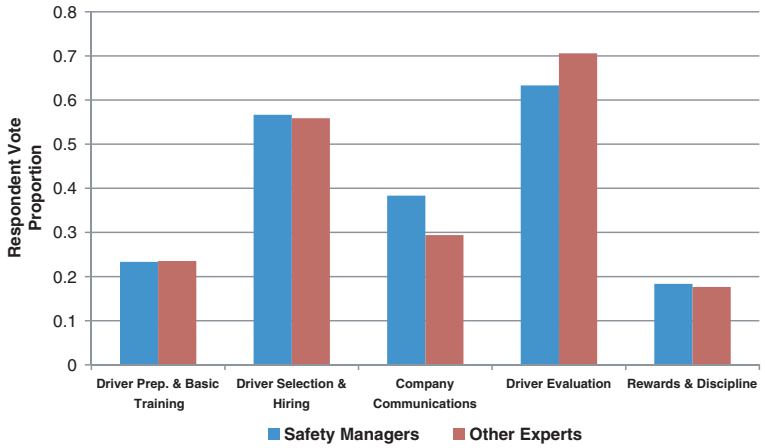


FIGURE 10 Judged safety importance of different management areas in *Synthesis 21* survey. Each respondent had two votes. *Source:* Knipling et al. (2011).

*CTBSSP Synthesis 21* (Knipling et al. 2011) identified additional carrier methods to improve commercial driver selection, with emphasis on specific tests and measurements used in making employment decisions. The study identified 15 driver hiring practices reported to be effective for motor carriers, and an additional nine practices that might be helpful for some fleets. The following are some of the key hiring practices applicable to companies of any size:

- Use multiple types of assessments (e.g., driving test, interview, and review of records) to capture a variety of driver characteristics and the "whole person."
- Use the FMCSA PSP service to see past crash involvements and inspection data.
- Review driving records with special focus on major violations (e.g., reckless driving).
- Assess past crashes with regard to preventability and, when possible, specific causes.
- Conduct a road and range driving test of every applicant using a standardized checklist or rating form.
- Conduct a standardized interview to tap key driver safety-related traits and skills directly related to the job.
- Assess, either through interviews or questionnaires, driver personality traits such as aggressiveness, impulsiveness, conscientiousness, agreeableness, manageability, and attitudes toward risk.
- Select for retention as well as for safety, as the two are associated.
- Provide applicants with as much information as possible on the company, job, and hiring procedures so there are "no surprises."
- Maintain a detailed and comprehensive assessment file for each driver.
- Require a probationary period for new hires.

In the *I-95 Corridor Coalition Coordinated Safety Management* study (Stock 2001), a large majority of respondents from all carrier size categories considered driver hiring criteria to be important to safety. Among trucking companies in the 10–24 vehicle category, more than 80% required in-person interviews, tested for alcohol and drugs during screening, and conducted on-road driving tests before hiring. Small (10–24 vehicle) carrier percentages relating to other specific practices were as follows:

- Use third-party services to review driver histories: 39%.
- Require a minimum number of years of experience: 52%.
- Allow specific maximum number of points/crashes/violations: 80%.
- Require a written test on DOT regulations: 40%.

In the Stock study (2001), the percentage of carriers engaging in various hiring practices generally varied directly with carrier size. For example, the percentages of responding carriers requiring a minimum number of years of experience for drivers were: 1–9 vehicles (50%), 10–24 vehicles (52%), 25–50 vehicles (64%), 51–100 vehicles (67%), and >100 vehicles (73%). Bus respondents (all sizes combined) were at 48%. Although Stock's data are probably indicative, they are more than ten years old and were not statistically representative of all U.S. carriers. A qualitative difference between small carriers and large ones was also noted in the study. No statistics were provided, but Stock reported that some of the small carriers in that study stated that they hired only drivers who were personally known to them prior to hire. This might be an advantage for small carriers, although it suggests that these carriers are not casting a wide net in their driver recruiting.

### Employee Hiring in Small Companies

Two nontransportation management studies provide insights into employee recruiting and hiring in smaller companies. Carroll et al. (1999) asked whether small companies use

systematic, formalized hiring procedures such as those outlined in textbooks or used in some large organizations. The companies studied ranged from 7 to 207 employees, and represented 5 different sectors, including trucking. They found that often small companies generally hire workers in an informal manner. None of the companies conducted job analyses, in part because they believed that job tasks were variable and that written descriptions would be too rigid. Most companies preferred *closed searches* for new hires. That is, instead of conducting an open search using advertising or recruitment agencies, they favored simply "spreading the word" among existing employees that they were hiring new staff. Managers assumed that their current employees could judge their acquaintances' suitability for the job and whether they would "fit in" well in the company. The hiring emphasis was often on "interpersonal fit" rather than on an objective comparison of job tasks and requirements to applicant qualifications.

In a similar study of 27 firms in Australia, Barrett and Neeson (2007) found that many small companies did not analyze their jobs and had no list of required skills or other qualifications for their jobs. Most of their managers could verbally state the attributes they were looking for in new employees. However, those without written documentation of job requirements had difficulty reliably assessing new applicants. This Australian study went one step further: it compared the use of formal hiring and other HRM practices with company growth. The study found that 16 of the 27 small companies that formalized their HRM processes [e.g., by documenting job tasks, knowledge, skills, and attitudes (KSAs), and minimum employee qualifications] were more successful in finding better employees than the 11 that did not. Managers of companies with formalized HRM processes and documentation were able to "sell their vision" of employee and company success to new applicants. This clarity of purpose appeared to help these companies make a profit and grow over time.

Marchington et al. (2003) conducted case studies of trucking firms in Britain and their driver hiring practices. All were small-to-medium family businesses that had been in operation for 20 years or more. These carriers were concerned both about the shortage of qualified drivers and the difficulty of finding good drivers when applicants were scarce. However, the companies were not aggressive about hiring new drivers and about company growth in general. Reasons for their general reticence to grow included:

- They were generally satisfied with their market niche and current close customer relations;
- They were somewhat afraid to grow larger and thus be forced to compete with "the big boys";
- They did not want to invest in new facilities, equipment, and personnel; and
- There was a strong desire to maintain family control and succession to future generations. These might be threatened by rapid or excessive growth.

Marchington's companies tended to hire drivers they already knew, such as individuals initially hired for other jobs in their companies. They often hired their former drivers who had left for other firms but then returned. Study companies did not approach driver hiring in a systematic or formal manner; they did not employ personnel specialists, did not conduct job analyses, and did not like working with driver recruiting firms. The companies often found themselves recruiting drivers continuously over long periods of time to field sufficient drivers for their workload. A general strategy was to maximize driver retention by establishing personal relationships with each driver hired as well as providing competitive pay and other tangible benefits.

#### Survey and Interview Findings

Survey Question 6 asked respondents to rate the safety importance of "recruiting and selecting good drivers." This item received an average of 3.3 on the 0–4 scale, the highest average rating assigned to any of the 14 safety problems presented. In Question 31, driver selection and hiring was rated as the most important of ten safety management areas presented. Questions 17 and 18 concerned specific driver hiring practices. On Question 17, 92 of 110 respondents indicated that they conducted road and range driving tests with all new driver applicants. Those using the practice assigned it a mean effectiveness rating of 3.0 on the 0–4 scale. Question 18 asked if respondents "have driver applicants complete a questionnaire on attitudes, personality, or driving behaviors." Only 20 of 112 respondents did so, and it also received a mean effectiveness rating of 3.0 from practitioners.

A number of survey comments addressed driver selection and hiring, including the following:

- It is all about having/hiring the right people who have the right attitude. Then monitoring their progress helps keep them on track.
- We only hire experienced competent drivers. They know their job.
- The most important safety feature in a truck is the driver. That is why we are very selective in our recruiting and try to be at the top of the pay scale to attract the highest quality driver.
- Know who you are hiring, and do not make exceptions to hiring good drivers. It will harm you down the road.
- Our biggest company problem is finding drivers.

All ten of the case study interviewees either chose "driver selection and hiring" as a most-important safety management practice and/or mentioned it as such in their comments. Most of the managers personally interviewed and road tested driver applicants. Often the managers already knew driver applicants before they applied. By and large, however, driver selection procedures were not as elaborate as those described

by larger carriers in *CTBSSP Synthesis 21* on driver selection (Knipling et al. 2011). The one large company interviewed for this study, Carrier J, believed that the systematic driver hiring regimen it imposed on its subsidiaries was important in maintaining company-wide driver quality standards.

## DRIVER ORIENTATION, TRAINING, AND COMMUNICATIONS

An organization's commitment to employee safety training and other communications is a strong indicator of its overall safety culture and climate. Effective safety training has been shown to have a negative correlation with occupational injuries in a workplace (Huang et al. 2006). Comprehensive, behavior-based safety training increases company safety performance and safety culture.

A study published in 1995 by FMCSA's predecessor agency (Dueker 1995; FHWA Office of Motor Carriers 1995) assessed the entry-level training of U.S. CMV drivers. In the study, a panel of 36 experts reviewed statistics on the training received by CMV drivers and of curricula used in that training. The study concluded that neither heavy truck nor motor coach drivers generally receive adequate entry-level training. The driving and overall job proficiency required to earn a CDL is widely regarded in industry as well below the level required for reliable driving in a full-time operational setting. Thus, the adequacy of driver skills and knowledge is a major industry safety concern. For example, improved commercial driver training was the top recommendation from the 2002 *International Truck and Bus Safety Research and Policy Symposium* (Zacharia and Richards 2002). Driver training was the focus of *CTBSSP Synthesis 5* (Staplin et al. 2004), as well as *CTBSSP Synthesis 13* (Brock et al. 2007).

This report does not focus on entry-level CMV driver training; that is, the training that drivers may receive before obtaining a CDL. Rather, it addresses small carrier challenges and activities involved in "finishing" training for new drivers ("pre-service" training) and in providing their experienced drivers with continuing training ("in-service" training). Safety meetings are another form of communications that overlap with training in both their content and methods. Also relevant to the current discussion is training that carrier owners and managers themselves may obtain to upgrade their business, technical, and management skills. This section addresses training and communications content first, followed by training and communications methods and media.

### Training and Communications Content

The potential content of CMV safety training encompasses all driver and other employee KSAs relevant to safe CMV driving. *CTBSSP Synthesis 5* (Staplin et al. 2004) reviewed basic training content and curricula, including a detailed model curriculum recommended in the 1995 FHWA OMC report (Dueker 1995). The 1995 model curriculum was itself based on a 1985 FHWA OMC report. Areas of instruction include basic vehicle operation and handling, safe operating procedures, special driving conditions, advanced driving skills (e.g., recovering from skids), vehicle-related nondriving activities (e.g., pre-trip inspections), vehicle maintenance, nonvehicle activities (e.g., maintaining logs), passengers, and driver fitness (e.g., alcohol and drugs). The current Professional Truck Driver Institute model curriculum (PTDI 2011) is based largely on this earlier work.

In its survey and literature review, *CTBSSP Synthesis 5* attempted to assess salient driver training needs beyond entry-level training; that is, for carrier finishing training or continuing driver refresher training. The topic assessment also addressed potential training methods. The following candidate training topics were addressed:

- On-road speed and space management
- Driving in hazardous weather conditions
- Rollover prevention
- Night operations
- Tight maneuvering
- Emergency maneuvering
- Vehicle inspection and maintenance
- Bus passenger safety
- Truck coupling
- Cargo loading, unloading, and securement
- Driver wellness
- Fitness-for-duty and fatigue management
- Management of work schedule and family time
- Management of finances.

*CTBSSP Synthesis 5* also suggested crash causation findings as a basis for driver training content. For example, the LTCCS (Starnes 2006) identified and provided statistics on the Critical Reasons (proximal causes) triggering large truck crashes. This includes various types of driver errors as well as vehicle and environmental causes. Along with proximal causes, drivers need to understand crash risk factors; that is, pre-trip and pre-crash-threat factors that can make crashes more or less likely to occur. These were discussed earlier in Operational Planning and Risk Avoidance based largely on *CTBSSP Synthesis 21* (Knipling 2011).

In the UM survey of safe motor carriers, Corsi and Barnard (2003) reported that 71% of their small-carrier respondents required pre-service training (i.e., for new hires), usually of 1 to 2 weeks duration. Eighty-three percent required in-service training (e.g., refresher training). Many small carrier respondents (43%) believed the two training approaches had equal safety impact. Of the remainder, in-service training was rated as having greater impact by more respondents (38%) than pre-service training (19%). 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, HOS regulations,

***North American Fatigue Management Program Instructional Modules Under Development***

1. Introduction and Overview
2. Fatigue Management Practices
3. Driver Education
4. Driver Family Education
5. Train-the-Trainer
6. Shippers and Receivers
7. Sleep Disorders (for Managers)
8. Sleep Disorders (for Drivers)
9. Driver Scheduling and Tools
10. Fatigue Management Technologies.

injury prevention, pre- and post-trip inspections, and truck maintenance. The vast majority of small company driver training was conducted entirely by company personnel rather than outside parties. About 80% of small company managers considered their company-based training to be "a strategic safety investment." However, only 17% of small company respondents believed that their company "spends more time on pre-service training than do most carriers." For in-service training, the percentage was 25%.

There are no federal requirements regarding training for commercial drivers before obtaining their CDLs; instead, there is the performance requirement of passing the test. A 2004 FMCSR does require, however, that drivers receive instruction in four specific topics within 90 days of beginning work as a commercial driver. The four topics are: (1) driver qualifications (e.g., medical conditions), (2) HOS and fatigue prevention, (3) driver wellness (diet, exercise, stress reduction), and (4) whistleblower protection. Total instructional time for the four topics is estimated at about 10 hours. In recent years, many companies have voluntarily increased their in-service training and counseling on driver wellness and fatigue management. In *CTBSSP Synthesis 15,* Krueger et al. (2007) reviewed corporate health and wellness programs in the CMV industry. These programs implement employee training, communications, individual counseling, medical screening, and other methods to encourage healthful behaviors (e.g., exercise and better sleep hygiene) and reverse risk behaviors (e.g., smoking and unhealthful eating). *CTBSSP Synthesis 15* reviewed a number of successful truck and bus driver wellness programs, although all were in larger fleets. A joint U.S.–Canadian program, the North American Fatigue Management Program is developing a driver and carrier manager training system and website to support carrier-based training in companies of all sizes. The textbox provides a topical list of instructional modules under development. Most of these will be available both as web-based instruction and as courseware to support classroom lectures. Drivers are the principal instructional audience but some modules are for drivers' families, carrier managers, executives, or shippers/receivers.

The first five survey questions related to safety problem areas that also could constitute training topics. These were Likert scale items where respondents rated the importance of the problem on 0–4 scale. The average rating among 14 items was 2.6, which might be regarded as a benchmark for distinguishing problems of greater or lesser *relative* importance. The five items were:

1. Lack of basic driving skills among your drivers: 2.9.
2. At-risk driving behaviors (e.g., speeding and tailgating): 3.1.
3. Driver fatigue/drowsiness: 2.9.
4. Driver health, wellness, and nutrition problems: 2.4.
5. Driver personal, family, and financial problems: 2.2.

#### Training and Communications Methods

*Conventional Training Methods*

In *CTBSSP Synthesis 13,* Brock et al. (2007) overviewed training strategies and methods applicable to the CMV industry. Some advanced methods (e.g., driving simulators and skid pads) are employed only in the largest and most innovative schools and fleets. The traditional, core instructional methods of classroom lectures and supervised driving dominate most carrier-based training. This training is often supplemented by written materials and may be further enhanced by the use of audiovisual presentations (e.g., videos). Supervised driving includes both road and range settings. In their survey of safe motor carriers, Corsi and Barnard (2003) reported that the majority of their small-carrier respondents required both pre-service and in-service training, and employed classroom, in-vehicle road, and in-vehicle-range training venues. Relative to large carriers, smaller carriers made greater relative use of in-vehicle road training, but relatively less use of in-vehicle range and classroom training.

Safety meetings overlap with training in both their methods and content. These meetings, which often include managers, dispatchers, drivers, and other safety-related fleet personnel, are a basic and useful means to promote and sustain safety awareness within fleets. The *SafeReturns* study of top-performing fleets (ATAF 1999a) found that fleets held regularly scheduled safety meetings, generally with mandatory attendance and paid attendance for drivers. Topics addressed include recent crashes or incidents, vehicle maintenance and inspection, defensive driving, health and wellness, fatigue management and HOS, winter driving, and nondriving topics such as loading dock practices and hazardous material handling.

In the I-95 Corridor Coalition "Best Practices" study (Stock 2001), 76% of responding carriers in the 10–24 vehicle range held regularly scheduled safety meetings, usually quarterly but sometimes monthly. Percentages were higher for larger fleets and lower for the very smallest fleets. Eighty-seven percent of all their respondents rated safety meetings as

being important to carrier safety. Most responding small carriers also displayed safety awareness posters and distributed safety-related letters, fliers, etc.

*E-Learning*

E-learning comprises various modes of remote web- and computer-enabled transfer of KSAs. E-learning encompasses computer-based training, web-based instruction (WBI), and other similar terms. A 12-year meta-analysis of e-learning research by the U.S. Department of Education (Means et al. 2009) found the following general advantages of interactive e-learning over conventional instruction:

- Improved knowledge and performance for most topic areas.
- Increased access with reduced travel time and expenses.
- Convenience and flexibility to learners.
- Sharper focus on required knowledge, skills, and competences.
- More likely to be the product of a systematic instructional design process, including validation of learning objectives and instructional content accuracy.
- Eliminates variations in learning arising from variations in instructor knowledge and competences.
- Better spacing of learning (allowing consolidation of knowledge between sessions).
- Reduced overall training time.
- Economies of scale.
- Better tracking and recording of trainee, organizational, and training system performance.

The advantages of e-learning are applicable to training in CMV transport. It potentially offers much to drivers, who often have extra time to devote to training by means of laptops while on trips (e.g., at stopovers or while waiting for loads), but precious little time at their home locations. E-learning affords drivers the opportunity to both refresh their basic knowledge and to acquire advanced and specialized knowledge on topics such as crash causation, hazardous materials transport, longer commercial vehicles and other truck configurations, and cargo handling and securement. Carrier managers, human resource managers, operations managers, sales staff, dispatchers, maintainers, and others can also benefit from e-learning offerings. In addition to ease of access, an advantage is that instructional content and quality can be standardized. Conventional carrier-based training varies widely in quality and comprehensiveness as a result of differences in trainer knowledge, experience, resources, and facilities (Brock et al. 2007).

A recent FMCSA report (Brock et al. 2011) focuses on the use of WBI to provide training in the FMCSRs. Although the training subject focus was the FMCSRs, findings from the study apply to other knowledge-based instructional topics. WBI has a particularly strong *potential* applicability to small carriers, because its use greatly reduces the need for both instructional facilities and expert trainers at remote locations. Essentially, drivers and carriers need only computers and online access.

The report notes further that WBI and other e-learning can be more interesting and engaging than conventional instruction. WBI can provide graphics, video, and sound of the highest quality. It can be more individualized and provide better measures of success. Interactive e-learning can adapt the pace, mode, and content of instruction to meet the learning needs of each student. A well-designed WBI program tests each student as he or she progresses through an instructional program and provides both corrective feedback and selection of the next appropriate unit of instruction. WBI is applicable to many different kinds of learning, but not necessarily advantageous for all; for example, it does not work well for training multi-step procedures such as some PM procedures.

Brock et al. (2011) cite a review by Dodds and Fletcher (2004) that identified a "law of thirds" in its evaluation of WBI and other e-learning effectiveness in various settings. Generally and approximately, e-learning reduces training costs by 33%, reduces needed instructional time by 33%, and increases learning by 33%. WBI is especially useful when personnel to be trained are geographically dispersed and/or in remote locations. For these and the reasons stated earlier, WBI is almost ideally suited for nationwide small carrier training initiatives, whether government-provided or commercial. One potential barrier to widespread use of WBI in the CMV industry is the limited computer proficiency of some drivers and managers. Although computer literacy has greatly increased throughout the industry in the past decade, not all drivers and carrier managers have access to computers or feel comfortable using them. Another potential barrier for small companies may be high per-student costs. This would apply in the situation where carriers pay a company fee for WBI access but do not have enough employees to fully utilize it.

Two survey questions asked respondents about training methods and media. Question 21 asked respondents if they used online training programs for drivers, other employees, or themselves. Just 35 of 111 respondents used online training programs; users assigned the practice an average effectiveness rating of 2.4 on the 0–4 scale. Question 22 asked if they used training media in-house, such as DVDs and PowerPoint presentations. Here, 65 of 110 respondents answered yes, and they assigned the practice a mean effectiveness rating of 2.6.

Driver and other employee training is a major job task for small company owners/managers. The Carrier E interviewee stated, "Go the extra mile for safety because it will come back to bite you if you do not. Do lots of training. Play by the rules." Two case study interviewees noted the driver training support their companies receive from their insurance carriers.

For example, one provides maintenance and driving training materials and a safety newsletter for employees. In discussing plans for further growth, interviewees mentioned that they would like to be able to delegate driver training to another company employee instead of doing it themselves.

## DRIVER SUPERVISION

Once drivers are hired, oriented, and trained, they must be supervised. This section deals with management and supervision of drivers during their tenures with companies. Key management functions include evaluating drivers, determining and applying management actions (i.e., rewarding and punishing driver behaviors), and working to retain drivers. These three functions are addressed in the following sections.

### Driver Evaluation

Measuring and evaluating driver performance is a key element of carrier safety management. Recall from Figure 4, for example, that it is a major aspect of successful safety and health management systems. Recall also the earlier discussion of survey results from *CTBSSP Synthesis 21* (Knipling et al. 2011) in which both carrier safety managers and other experts in motor carrier safety were asked about the relative importance of five different areas of safety management. The five areas were (1) driver preparation (e.g., entry-level training), (2) driver selection and hiring, (3) communications (e.g., safety meetings), (4) driver evaluation, and (5) driver rewards and discipline. Both respondent groups rated the two *assessment* activities, driver selection and driver evaluation, as being more important than the other three functions, which could be characterized as *behavior change* activities. Figure 10 illustrated these survey results.

Multiple aspects of driver performance can be monitored, including driving skills and habits (through direct observation), vehicle care (e.g., pre- and post-trip inspections), roadside inspection violations, moving violations, crashes (of various categories), near-misses, cargo loss, other incidents, vehicle care, and loading and unloading practices (ATAF 1999b; Knipling 2009). Measuring employee performance is important for at least two fundamental reasons. First, it informs management both with regard to the individual's performance, but also with regard to potential company-wide issues. Second, it permits feedback to employees. The *Feedback Principle* is one of the most universal psychological principles (Holland 1975). Feedback, also known as knowledge of results, consistently facilitates learning and performance improvement. Feedback is most effective when it is immediate (or as prompt as possible), behavior-based, objective, credible (i.e., regarded as valid), and constructive. "Constructive" means that it is presented in a way that suggests a path to improvement, rather than just as blame for failure.

CSA is a major paradigm shift in government safety surveillance because it monitors every driver individually in addition to monitoring carriers (Bearth 2010). In addition, far more safety-related data are recorded. Under CSA, every inspection and moving violation (including official warnings) is recorded, whereas in the past it was only OOS violations and moving violation convictions. CSA puts drivers with serious violations under probation and then suspends their licenses for a second serious violation during the probationary period. Each of the seven CSA BASICs provides a measure of driver safety. Carriers can monitor these metrics along with their own performance evaluation metrics. A caveat is that a high majority of small carriers have insufficient compliance data to be reliably ranked under the CSA SMS (GAO 2011). Nevertheless, a carrier's recorded data relating to each of the metrics is accessible to the carrier for monitoring.

Beyond the tracking of driver violations and other outcomes, carriers can directly monitor their drivers' behaviors. Onboard safety monitoring (OBSM) is potentially a very strong technique for driver evaluation, because it has all the features of effective performance measurement and feedback to drivers (Hickman et al. 2007; Knipling 2009). Driving behaviors that may be monitored include top speeds (also known as overspeeds), sharp vehicle decelerations (i.e., hard-braking), lateral accelerations (indicative of speed on curves), idling times, and fuel usage. If vehicles lack dedicated onboard monitors, they can still be taken to a dealership for a readout of the engine ECM (as is done by case study Carrier H). Crash avoidance systems such as Forward Collision Warning can also be monitoring systems to detect at-risk behaviors such as tailgating. Advantages of OBSM over conventional driver safety measures include the following (from Knipling 2009):

- OBSM provides a 100% sample of driver behavior.
- It captures specific behaviors that cause crashes, incidents, and violations.
- Positive driving behaviors can be seen and rewarded.
- Negative driving behaviors can be seen and corrected before a crash, incident, or violation occurs.
- Driving behavior-based benchmarks can be established so drivers know where they stand in relation to carrier expectations.
- Evaluations, feedback, and consequences (including both rewards and punishments) can be frequent and timely.

Carriers monitor individual driver fuel economy to reduce costs, but it can also be an effective form of safety monitoring. Drivers who excel in fuel economy are also "smooth operators." They tend to glide through traffic, avoiding rapid accelerating and decelerations. They drive defensively with good space management. An international initiative called "Ecodriving" has trained thousands of heavy vehicle operators on driving techniques to reduce fuel usage. One Ecodriving training program reduced truck driver fuel consumption by

27%, gear changes by 29%, and hard brake applications by 41% (Symmons and Rose 2009).

The I-95 Corridor Coalition "Best Practices" study (Stock 2001) found that more than 90% of carriers of all sizes regularly monitored their drivers' citations. Most also closely monitored HOS and logbook violations, although percentages were not as high for smaller carriers. Carrier size differences were seen in several types of driver behavioral evaluation as follows:

- Observe drivers on the road
  - Small (10–24 vehicle) carriers: 25%
  - Large (>100 vehicle) carriers: 54%.
- Use motorist call-in number to receive comments ("How's My Driving?"):
  - Small carriers: 17%
  - Large carriers: 30%.
- Use OBSM or vehicle tracking:
  - Small carriers: 16%
  - Large carriers: 45%.

Corsi and Barnard (2003) reported that most driver evaluation criteria used by carriers are outcome-based as opposed to behavior-based. They include crashes, FMCSR violations, traffic violation convictions, and public complaints. The researchers noted a difference between large and small carriers in their methods of evaluating drivers. Large and small carriers were roughly equivalent in their use of various driver safety metrics based on time (e.g., crashes and violations over the past year). However, large carriers were much more likely to use metrics based on mileage exposure. For example, 46% of large (>95 vehicle) carriers tracked driver crashes over a specified number of miles, whereas only 17% of small (1–24 vehicle) carriers did so. Although basing driver metrics on mileage exposure requires more recordkeeping and tabulations, it generally provides more valid assessments.

Question 7 asked the importance of "Assessing driver on-road safety (i.e., knowing how safe your drivers are)." Respondents gave this safety problem an average rating of 3.0 on the 0–4 scale, putting it near the top of the 14 items surveyed. Question 24 asked if carriers monitored individual driver fuel economy. As discussed earlier, driver fuel economy is a valid safety metric in addition to being an efficiency measure. Of 112 respondents, 80 monitored driver fuel economy. As a safety management practice, it received a mean effectiveness rating of 2.8 on the 0–4 scale.

Question 31 presented ten areas of carrier safety management and asked respondents to select up to three that were the most important. Choice (c) was, "Driver evaluation (i.e., violation and incident tracking, ride-alongs, covert observations of driving, onboard computer monitoring)." This choice received the fifth most votes of the ten items. As noted previously, driver evaluation was rated the most important of five safety management areas in the *CTBSSP Synthesis 21* survey (Knipling et al. 2011).

A few case study interviewees had vehicles equipped with OBSM and/or monitored driver fuel economy. Carrier H did not have onboard computers but did get a quarterly download of data from its vehicle engines' ECMs. This allowed them to review records for overspeeds and hard braking events.

#### Rewards and Discipline

Perhaps the most powerful and far-reaching principle in behavioral science is the Law of Reinforcement and Punishment, also known as the Law of Effect (Holland 1975). It states that behaviors that are rewarded will continue and likely increase in frequency, whereas those that are punished will generally decrease in frequency. Although most people do not think of this as a scientific principle, they practice it every day in their interactions with their co-workers, their family members, and their pets. Both rewards and punishments have strong effects on future behaviors. Over the long term, rewarding desired behavior is a more reliable and effective approach than is punishing undesirable behavior (Krause et al. 1999; Hickman et al. 2007). One can shape and sustain complex behaviors (e.g., following multiple safety rules and procedures) with positive rewards, including nonmaterial rewards such as positive recognition. Punishments can reduce unwanted behaviors, but they also provoke negative emotions such as aggression and escape. For commercial drivers, "escape" means turnover and churning.

Behavior Based Safety (BBS) is the application of behavioral science to industrial safety. BBS engages workers in the improvement process, teaches them to identify and observe critical safety behaviors, provides feedback to encourage improvement, and uses gathered data to target system factors for positive change (Krause et al. 1999; Hickman et al. 2007). BBS combines applied behavior analysis, behavior modification, quality management, organization development, and risk management. It makes heavy use of rewards, usually in the form of positive recognition, to reinforce safety improvements. Material rewards such as pay bonuses may be used, but many BBS practitioners believe that awarding large pay bonuses for safety can become a source of discord within organizations, as those not receiving the awards may believe that they have been treated unfairly. BBS has an unmatched record of success in preventing occupational accidents and injuries in industrial settings such as factors and utilities. Guastello (1993) reviewed 53 occupational safety and health studies and found that applying BBS reduced injury rates by an average of 60% across the studies.

Unfortunately, commercial vehicle transport is not an ideal setting for applying conventional BBS methods such as direct behavioral observation and group-based feedback. The work of commercial drivers is largely solitary and geographically

removed from their home work station. OBSM, described earlier, is the most effective means of providing the necessary observations of safety behaviors upon which to base improvement efforts. Another (and complementary) approach is behavioral self-management (Geller and Clarke 1999). Drivers may be taught to consider their own at-risk driving behaviors, their antecedents (situations leading to them), and their consequences. Drivers are encouraged to objectively observe and measure their own behavior, set goals for improvement, self-monitor their progress, and reward themselves for successes. Successful behavioral self-management can be reinforced by positive recognition by the carrier and by tangible rewards. Figure 11 shows a behavioral flowchart model of behavioral monitoring (see the earlier evaluation discussion) and behavior change interventions (e.g., feedback and positive reinforcement) reduce risk, which in turn reduces crashes, violations, and their consequences.

The most obvious reward for working is pay, and most CMV drivers are paid by the mile. Incentive pay by productivity is well-established in trucking and in many other professions; however, an inherent concern is that it may foster at-risk behaviors such as working excessive hours and speeding. Recognitions and rewards for driving safety are a way to counterbalance productivity incentives and establish an expectation and social norm of safety within a company.

Structuring a system for recognition and rewards for safe driving behaviors has proven effectiveness in CMV transport. Nevertheless, nearly all carriers must also issue reprimands and penalties for driver offenses, and they are rated effective by managers in surveys (e.g., Corsi and Barnard 2003; Knipling et al. 2003). Punishment is effective for reducing or eliminating specific behaviors. It is important that penalties be applied uniformly for specific, announced behaviors (e.g., following too closely) or "non-behaviors" (nonuse of safety belts). Punishments are to be timely and certain, but they do not have to be severe to be effective (Hickman et al. 2007; Knipling 2009). BBS emphasizes that consequences be in response to specific behaviors, not personality traits or attitudes. In other words, "punish the sin but not the sinner."

In a management textbook covering all types of businesses, Nelson and Economy (2005) suggested the following sequence of disciplinary steps for employees performing poorly or misbehaving: (1) verbal counseling, (2) written counseling (i.e., document incident and any consequences), (3) giving negative performance evaluations (e.g., in an annual evaluation), and (4) termination. In CMV operations, a possible intermediate disciplinary step between (3) and (4) is temporary suspension.

In the FMCSA/UM Survey of Safest Motor Carriers, Corsi and Barnard (2003) reported that 77% of its responding carriers had safety reward programs for individual drivers. Small carriers were less likely to have a rewards program than were medium and large carriers, however. The respective percentages were 48% for small carriers (1–24 vehicles), 90% for medium carriers (25–94 vehicles), and 91% for large carriers (>95 vehicles). Types of rewards included verbal praise, public recognition, letters from management, safety decorations, cash, and merchandise. Ordinarily, rewards were time-based (e.g., one year of crash-free driving) rather than mileage-based. This was especially true for small carriers.

In the I-95 Corridor Coalition "Best Practices" study, Stock (2001) found that 49% of responding small (10–24 vehicle) carriers offered their drivers incentive or bonus programs for safety performance, whereas 82% of large (>100 vehicle) fleets did so. Larger carriers were also somewhat more likely to reward drivers for making safety suggestions, and to


FIGURE 11 Behavioral model for reducing crashes, violations, and associated consequences through monitoring and behavior change. *Source:* Knipling and Hyten (2010).

encourage drivers to participate in safety championships (that often are organized by state trucking associations).

In a study of carrier safety in relation to economic health, Rodriguez et al. (2004) found that small carriers with high liquidity tended to have better safety performance. Liquidity was defined as the ratio of net carrier operating income to outstanding debt. The effect was not strong, but it suggested to the authors that financially healthy firms were better able to properly reward and equip their drivers. Consistent with this finding, the study also found that small firms that devoted a higher share of their revenues to labor expenses tended to have better safety outcomes. According to the authors, "these results suggest that it is important for public policy to encourage small firms to rely on higher driver compensation in place of the kind of driver monitoring, training, and supervision that larger firms can provide."

Question 8 asked the importance of "Correctly rewarding good driver behaviors and disciplining bad behaviors." Respondents gave this safety problem an average rating of 2.9 on the 0–4 Likert scale, making it the fifth highest of item averages. Question 20 asked if carriers gave drivers bonuses or other rewards for safe driving. Approximately half of the respondents, 52 of 111, did so. As a safety management practice, it received a mean effectiveness rating of 2.8 on the 0–4 scale. Question 31 presented ten areas of carrier safety management and asked respondents to select up to three that were most important. Choice (d) was "Driver performance consequences; that is, rewards and discipline." Surprisingly, perhaps, this choice received the eighth most votes of the ten items.

The following are some survey comments relating to the general topic of driver supervision:

- If you hire correctly, train effectively (not only at hire but throughout employment), use onboard monitoring, and set your trucks at 65, you will do fine in all departments. . . . Safety does pay.
- Driver training and CDL requirements for motorcoach drivers are very low in the United States compared with other developed countries (Europe).
- Do not get so big that the owner does not know every person on payroll and make it their business to personally check out every driver every day! Big companies are a big problem when they look only for income and not their relationship with those who provided it.

#### Retention

There is a current and continuing shortage of qualified commercial drivers in the United States, in spite of the high unemployment rate. Commercial driver turnover, owing in large part to driver "churning" among different companies, continues to be an industry problem, especially in the truckload sector (Knipling 2009; ATRI 2011). ATA conducts a quarterly survey of driver turnover rates in large truckload carriers, smaller truckload carriers, and LTL carriers. Turnover rates decreased during the "great recession" of 2008–2009, but the most recent statistics from the first quarter of CY 2011 find rates rising again (Watson 2011). The annual driver turnover rate for larger truckload fleets (those with $30+ million in sales) rose to 69%, whereas that for smaller truckload fleets was at 50%. Consistent with past findings, the driver turnover rate at LTL fleets was much lower at 8%. Among truckload carriers, the smaller companies' advantage appears to reflect the more personal relationships found between management and drivers. Quoted in *Transport Topics* (Watson 2011), Richard Mikes, a former official with Ruan Leasing, stated that smaller fleets "seem to relate better to their drivers. The driver is definitely viewed on a personal basis." He added that smaller fleets tend to run shorter trips, which gives drivers more time at home.

Driver retention promotes safety in multiple ways, as listed in the textbox. Many of the same personal traits associated with driver safety are also associated with longevity as an employee (Knipling et al. 2011). These include emotional stability, agreeableness, and conscientiousness (Zimmerman 2008). In addition, longevity with a company changes drivers in ways that promote safety. Route familiarity is beneficial to safety (Knipling 2009). Retained drivers also become more proficient with company safety procedures and acceptance of safety policies. Low driver turnover means less management time spent on activities such as recruiting, hiring, and new employee orientation. This frees more time for supervision of drivers and operations. Further, there is a "positive feedback loop" between driver retention and safety (Knipling 2009). Improved safety makes a company more desirable for current and prospective drivers, which further supports retention.

With some exceptions, driver turnover rate varies directly with company size, giving small carriers a safety advantage in this aspect of safety and operations. A 1999 survey of 422 trucking firms (Min and Emam 2003) found that most small carriers (defined as those with 1–49 trucks) had low turnover

***Retention Improves Safety***

- Company employment more desirable.
- Retained drivers generally safer and more stable.
- Fewer "bad apples."
- Fewer entry-level drivers.
- Drivers more familiar with routes.
- Drivers more familiar with company policies and procedures.
- Less management time spent on hiring and training.
- More management time for current drivers and operations.

*Source:* Knipling (2009).

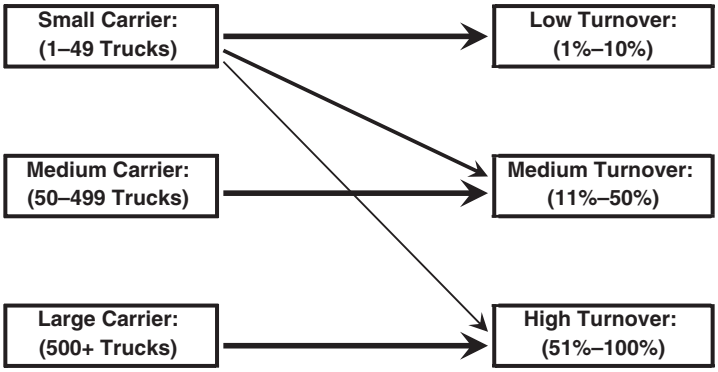


FIGURE 12 Simplified schematic of 1999 survey findings on carrier size and annual driver turnover rates. Based on Min and Emam (2003).

rates in the range of 1% to 10% per year. The corresponding rate in medium-sized carriers (50–499 trucks) was 11% to 50% annually, whereas in large companies it was 51% to 100%. However, this rule did not apply to every company. Among small companies, those running longer trips (e.g., national truckload carriers) tended to have turnover rates such as those of larger carriers. LTL carriers experienced much lower turnover than truckload firms. Figure 12 is a simplified schematic of study findings.

Min and Emam (2003) attributed the lower turnover rate in small companies to more personalized attention paid to drivers and more open communications. In addition to the truckload–LTL difference, the researchers found state-to-state differences in turnover rates, perhaps reflecting differences in economic opportunity. Among drivers in the same firm, those with tenures of six years or more were less likely to turn over. In other words, employment longevity begets employment stability. Employment with a small firm was associated with greater job satisfaction, but larger firms more often had the financial resources to attract drivers with higher compensation. The departure of older, longer-tenured drivers from small carriers for jobs with larger ones was usually motivated by higher pay and/or benefits.

Question 9 asked the safety importance of "Driver turnover resulting in an unstable workforce." Respondents gave this safety problem an average rating of 2.7 on the 0–4 Likert scale, putting it near the middle of the 14 items surveyed.

Although small carriers usually have lower turnover than similar larger firms, the case study interviews suggested large variations among carriers. Carrier C is a regional TL carrier with six trucks; its driver turnover rate is less than 10% annually. Carrier D, a short-haul TL carrier, also with six trucks, replaces approximately two-thirds of its drivers annually. The difference in this case might be pay; Carrier C runs high-productivity vehicles (HPVs), which allow it to haul more cargo and pay its drivers more than industry norms. Carrier B, a national TL lease operator, did not state a turnover rate but makes extraordinary efforts to keep its drivers happy and with the company. The Carrier B owner treats his drivers "like gold . . . I take care of them before I take care of myself," he said.

## CRASH AND INCIDENT INVESTIGATION

An important function of safety management is accident investigation, both for the purpose of resolving the accident in question, and also for preventing future accidents. When a motor vehicle crash occurs, managers are called on to investigate and document the causes of the crash and the extent of injuries and damage. This may include a visit to the crash site (if feasible), completion of company forms and other documentation, determination of fault/preventability, and decisions regarding corrective actions relating to the driver or procedures. Short et al. (2007) identified five goals of crash investigation:

- Determine fault and preventability
- Determine appropriate actions toward driver
- Learn lessons for future crash prevention
- Improve overall fleet safety
- Protect company from liability.

When a crash occurs, drivers need to document as much about the event as possible. Such documentation will directly assist carrier safety efforts and may reduce liability exposure. Most companies have their own crash and incident reporting forms (or checklists) that drivers carry with them. Insurance companies also provide standardized forms to their carrier clients. *CTBSSP Synthesis 1* (Knipling et al. 2003) includes a list of post-crash information items for documentation by drivers.

As part of the *I-95 Corridor Coalition Field Operational Test,* Stock (2001) looked at five different carrier practices relating to crash and incident investigation. As found with many other safety practices in their survey, larger carriers were generally more likely to have established, prescribed response practices following a crash or incident. Almost all

of the carriers in the study, regardless of size, instructed their drivers on what to do in the event of a crash. Except for the very smallest carriers (1–9 trucks), more than 90% in all fleet categories provided crash reporting forms. At the time of the study, very few mobile phones contained cameras. Instead, many drivers carried cameras in their vehicles to document incidents. In the study, 38% of carriers with 10–24 trucks provided drivers with cameras to document crashes, versus 62% of large carriers (>100 trucks). Smaller carriers were also much less likely to use trained specialists to investigate crashes, or to have an in-house panel to review them.

None of the survey questions specifically asked about crash investigation procedures. The case study interviews suggest that many small carriers, especially those with good safety practices, simply do not have enough crashes and incidents to feel the need to develop formal, in-depth investigation procedures. Managers were very aware of the negative consequences of crashes for their drivers and their companies. In addition to the human consequences, crashes greatly affect a company's financial viability (e.g., see Case Study D) and their CSA status (e.g., see Case Study H). Negative consequences are usually greatest for preventable (i.e., at-fault) crashes, but they may be significant for nonpreventable crashes as well.

## CARRIER PERFORMANCE TRACKING AND BENCHMARKING

As noted earlier in this chapter, a company's safety climate is best measured by leading indicators of safety activity and performance (Flin et al. 2000). Leading indicators are more likely to reflect ongoing behaviors, risk factors, and crash causes. Lagging indicators such as crash rates are more likely to reflect the past. In addition, infrequent and catastrophic outcomes such as crashes are more affected by chance. Companies need to track and benchmark safety measures that are current, diagnostic, and predictive of future outcomes.

In a study of industrial safety in general, Glendon and Stanton (2000) suggest that company safety performance should be monitored frequently. Steps in developing better safety monitoring are shown in Figure 13. By regularly measuring and monitoring safety, companies can better understand their sources of risk and appropriate responses to them. Regularly repeated measurements lead to continuous improvements. Glendon and Stanton stress the importance of external feedback; for example, benchmarking company practices against those of other companies to determine how improvements might be made.

Carrier safety performance is ordinarily tracking using a rate or likelihood statistic; that is, an incident or outcome numerator divided by an exposure denominator (Knipling 2009). Numerators include observed at-risk behaviors, crashes (defined by various criteria), crash costs, injuries, moving violations, incidents (e.g., cargo loss), inspection violations, and complaints. Denominators include vehicle-miles traveled, carrier number of power units, number of drivers, number of inspections, driver hours, trips, and pickups and deliveries. It is important that carriers consider the nature of their operations and risks and carefully select a set of meaningful metrics, those most likely to predict future safety outcomes. Metrics

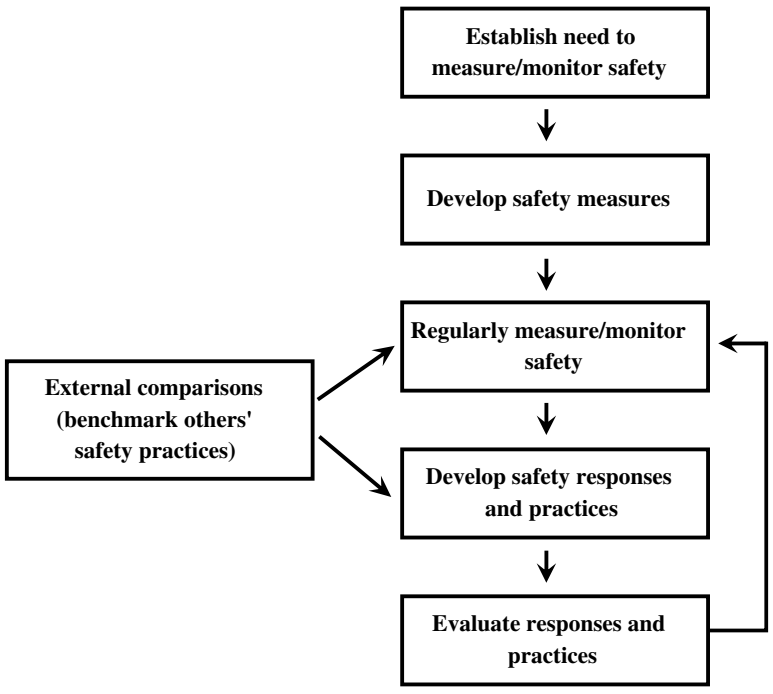


FIGURE 13 Developing and sustaining a company safety monitoring system.
*Source:* Glendon and Stanton (2000).

that naturally generate more data are almost always more reliable than those generating less data; for this reason, many carriers record and address every reported incident or failure regarding a driver or vehicle, no matter how small. The effectiveness of BBS in industry settings is the result of, in part, its practice of observing and recording many everyday behaviors to reduce at-risk behaviors and thereby reduce accident and injury outcomes (Hickman et al. 2007).

CSA provides a standardized set of safety metrics for carriers and drivers. The seven CSA BASICs are primarily leading indicators of carrier risk factors. They include Unsafe Driving (mainly moving violations), Fatigued Driving (mainly HOS violations), Driver Fitness (CDL, medical qualifications), Alcohol/Drugs, Vehicle Maintenance (vehicle roadside violations), Cargo Securement (based on inspection violations or mishaps), and Crash History (crashes weighted by severity and recency). Each BASIC generates a SMS score for each carrier and driver, and most of these are leaving indicators of crash risk (Strah 2010). SMS scores are automatically benchmarked against other carriers and drivers, providing, theoretically, the external comparisons suggested in Figure 13. Unfortunately, most carriers do not have enough inspections and other CSA-related events to permit reliable carrier rankings (GAO 2011). As one would expect, this is especially true for small carriers. GAO (2011) provides the following data sufficiency rates for carriers of various sizes, with "sufficiency" defined here as having enough compliance data for carrier safety ranking on *any* of the seven BASICs.

- 0–5 power units: 5.7%.
- 6–15 power units: 28.3%.
- 16–50 power units: 50.2%.
- 51–500 power units: 65.7%.
- >500 power units: 83.7%.

Survey Question 15 asked respondents to indicate the two most challenging CSA BASICs. One could consider the most challenging BASICs to also be the metrics small carriers regard as more important for compliance and continued operation. As was presented in chapter two, CSA Compliance Challenges, the top three items were (b) Fatigued Driving (HOS), (a) Unsafe Driving, and (e) Vehicle Maintenance. Question 29 asked if respondents, "track overall company safety statistics (e.g., crash and violation rates, financial losses from crashes)." Of 110 respondents, 97 indicated that they did so, and the practice was assigned a mean effectiveness rating of 2.7 on the 0–4 scale.

In the project case study interviews, few interviewees articulated an approach to safety monitoring as systematic as that seen in Figure 13. CSA is the primary safety monitoring "overlay" for the small carriers contacted. Almost all of the small carrier managers interviewed closely monitored CSA scores, which include both carrier safety measures (e.g., crashes and violations) and benchmarks against other carriers' performance. None of the managers interviewed mentioned internally generated company safety measures or benchmarks such as those in CSA, although many of them did collect and monitor such data on their individual drivers.

## MANAGEMENT DEVELOPMENT

In an earlier section of this chapter, the general challenges of business management, operational management, and safety management in small companies was reviewed. This section deals with the challenge of professional development for small carrier owners and managers in the area of safety. The safety-related competency levels and professionalism of motor carrier managers vary widely. Most were drivers earlier in their careers, and many also held management positions with other companies. As in almost any higher management position, however, the knowledge and competencies constituting a proficient worker or middle manager do not always transfer to success as a top manager. Consider the "generic" supervisor competencies listed in the textbox (from Bittel 1987). Most of these competencies are either unnecessary for commercial driving or are different in nature for drivers and carrier managers. Many former drivers are deficient in these competencies when they begin their own companies or are promoted to a management job. Ideally, professional development for carrier managers would have training and mentoring by more senior managers. In a family-owned business, mentoring comes from the older generation. The development process might include supervisory training, gradual expansion of responsibilities, close monitoring by senior managers, frequent feedback and guidance, and formal recognition for successes. This ideal scenario is probably atypical in small truck and bus companies, however, because many of them are new startups without an organizational heritage.

***"Generic" Supervisory Competences***

- Planning work
- Controlling work
- Problem solving
- Monitoring performance
- Performance feedback
- Coaching subordinates
- Motivating/rewarding
- Discipline/reprimands
- Managing time
- Oral communication
- Written communication
- Self-development
- Representing company
- Employee counseling
- Conducting meetings.

Adapted from Bittel (1987).

Many national and state CMV transport organizations offer professional training and related services to their members. Some programs offer formal certification for managers completing their courses of study. Others offer a combination of education and management-related services. Programs include:

- ABA Certified Travel Industry Specialist Program (www.buses.org).
- ATA Safety Management Council (www.truckline.com).
- NASTC Management and Safety Program (www.nastc.com).
- North American Transportation Management Institute (NATMI, www.natmi.org).
- National Private Truck Council (NPTC) Private Fleet Management Institute (www.nptc.org).
- OOIDA Education and Business Tools and webinar series (www.ooida.com).
- Truckload Carriers Association (TCA) Truckload Academy (www.truckload.org).
- United Motorcoach Association (UMA) Bus and Motorcoach Academy (www.uma.org).

Transport manager professional development does not have to be formal or expensive. Participation in transport organization meetings is one way to acquire new knowledge and skills. Some carriers have organized their own safety benchmarking groups (Knipling 2009). They meet several times annually and share information and ideas for improved safety. Any group of similar carriers could do the same. Carriers meeting with competitors must be careful to avoid discussing cost- and price-related issues, because this could be a violation of federal anti-trust (e.g., price-setting) laws. However, they can openly discuss safety management practices and learn from each other.

Fuller-Love (2006) reviewed literature concerning management development in small firms of all kinds. The article looked at the extent to which management development contributes to small company growth and whether a lack of management skills contributes to failure. The article also identified barriers to management development, including certain characteristics and attitudes of small company entrepreneurs. The review found that, on balance, management development programs are effective and beneficial for small firms. Five of eight studies reviewed showed positive effects. Documenting such positive effects is difficult because the benefits may not be immediate or easily quantified.

One key distinction made by Fuller-Love is that between business education and management development. Business education, as one might receive in a Masters of Business Administration degree program, is broader and covers many specific courses of study. Management development is more job-related and involves a mixture of education, training, and experience. Key management competencies taught include:

- Leadership development,
- Developing management systems,
- Team building,
- Strategic thinking and innovation,
- Delegation, and
- Various specific techniques and skills.

In general, small companies are less likely to engage in management training and development than are larger firms. This includes both in-house training and training from outside sources. Small business owners with prior background in business education are more likely to appreciate the benefits of management development and their businesses are more likely to be successful. Business failures are usually caused by structural problems such as under-capitalization, poor liquidity, and insufficient capital; however, such failures are usually accompanied by a lack of management experience as well.

Two obvious barriers to management development are time and cost. Solo managers rarely have the time to develop all the necessary competencies to sustain a growing business. In addition, they are often by nature independent, autonomous, and/or overcontrolling. They may not recognize or accept the need to develop professionally, or they may prefer the status quo regardless of possible lost opportunities. In contrast, successful entrepreneurs are open to both personal and business growth. They strive to create a "top team" to better cover the range of management tasks and skills required and to allow time for themselves and other top managers to think and plan strategically.

Table 17 presents five stages of business development as identified by Fuller-Love (2006). The table tracks the stages of successful company growth, top managers' roles, predominant management style, and typical organization structure. As a company grows and matures, different management roles, styles, and skills are required. A small business is mostly an extension of the owner; he or she is involving others in his or her life work. As the firm grows, direct ties decrease between the owner and company employees, and also between the owner and company work outputs. Rather dramatic personal and organizational transformations are required for a small company to grow successfully.

Previous CTBSSP Synthesis reports have addressed carrier management development, including *CTBSSP Synthesis 1: Effective Commercial Truck and Bus Safety Management Techniques* (Knipling et al. 2003), *CTBSSP Synthesis 12: Commercial Motor Vehicle Carrier Safety Management Certification* (Bergoffen et al. 2007), and *CTBSSP Synthesis 14: The Role of Safety Culture in Preventing Commercial Motor Vehicle Crashes* (Short et al. 2007).

In the *I-95 Corridor Coalition Coordinated Safety Management Study* (Stock 2001), carrier managers were asked about their primary sources of safety and compliance information.

TABLE 17
STAGES OF BUSINESS DEVELOPMENT

| Stage | Top Management Role | Management Style | Organizational Structure |
|---|---|---|---|
| 1. Inception | Direct supervision | Entrepreneurial individualistic | Unstructured |
| 2. Survival | Supervised supervision | Entrepreneurial administrative | Simple |
| 3. Growth | Delegation/coordination | Entrepreneurial coordination | Functional centralized |
| 4. Expansion | Decentralization | Professional administrative | Functional decentralized |
| 5. Maturity | Decentralization | Watchdog/ oversight | Decentralized functional/product |

*Source*: Fuller-Love (2006).

By and large these sources also provide information to help carrier owners and managers develop professionally. Percentages were as follows for trucking managers in the 11–25 vehicle category. Note however that this was survey was taken before the growth of the Internet.

- State carrier associations (71%)
- Insurance companies (67%)
- Periodicals (57%)
- U.S.DOT (37%)
- National carrier associations (32%)
- Safety consultants (28%)
- State enforcement agencies (26%)
- Other private sources (25%).

A separate sub-study of the same program (Stock et al. 2001) developed, pilot tested, and evaluated motor carrier safety education and outreach materials for managers of small motor carriers. Specific products developed included a three-hour seminar, a brochure highlighting frequently used management practices of safe carriers, and an interactive, web-based "safety toolbox" to allow motor carriers to benchmark their safety management practices. Participants rated the importance of various management training topics. Top-rated areas included:

- Pre-employment driver screening and testing,
- Top management commitment and involvement in safety,
- Driver training (e.g., defensive driving, fatigue management, and equipment inspection), and
- Monitoring driver performance (e.g., citations, HOS logs, crashes, and incidents).

Other topics rated but not receiving the highest importance rankings included:

- Vehicle inspection and PM,
- Scheduled safety meetings,
- Integration of safety into compensation and retention programs,
- Safety recognition/rewards programs,
- Crash/accident review process, and
- Safety awareness posters, letters, messages.

Survey Question 12 asked respondents to rate the safety importance of "Not enough management time to adequately address all safety management problems and issues." The average importance rating for this item was 2.4 on the 0–4 scale, the 10th highest of 14 average ratings. Thus, the item was considered important, but not a priority among the problems presented. Responses to Question 14 ["Lack of training materials (or easy access to them) for yourself as a manager."] were similar. The mean rating was 2.2, putting it thirteenth of 14 items presented. Question 30 asked whether respondents participated in formal or informal meetings with their peers (e.g., truck or bus association meetings). Seventy-three of 109 respondents did so, and they rated its safety effectiveness 2.9 on the 0–4 scale.

In the case studies, the Carrier H interviewee mentioned that attendance at truck shows is beneficial because he receives training and information on both business and safety practices. Carrier H also shares safety information, resources, and ideas with another carrier with a similar operation. Carrier I, a bus charter company, participates in a 20-carrier idea-sharing consortium organized by the UMA. Participating carriers meet several times annually to discuss all aspects of bus operations and safety.

## SYSTEMATIC APPROACHES TO MOTOR CARRIER SAFETY MANAGEMENT

This section describes several approaches to integrating multiple safety management concepts and practices in a motor carrier or similar (e.g., transit) setting. These approaches employ some of the safety culture and safety climate concepts discussed in a more generic context earlier in this chapter. The approaches and examples described in this section are systematic in a least two different ways. First, they represent logical, step-by-step approaches to problem solving. Second, they employ multiple interventions encompassing human, vehicle, and environmental factors. Driver safety is addressed through "cradle-to-grave" human resource management practices, beginning with driver recruiting and continuing after employment with driver training, communications, performance measurement, and behavioral management.

### Basic Safety Management Systems

The FTA recently published a guide to safety management in transit agencies (Ahmed 2010). Although some of this guide is specific to the transit mode and/or to large organizations, much of it is generic and applicable to transport companies of all sizes and modes. The following definition and description of safety management systems is derived primarily from the FTA report.

A safety management system is an explicit element of transport company management responsibility. It sets out a company's safety policies, defines how it identifies safety hazards and controls risks, and provides for goal setting, planning, and measuring performance. A safety management system is established at the company level, but devolves out and down to all company departments, employees, and activities. Each of these has its own safety processes and procedures. In addition to reactive procedures (e.g., crash and incident investigation), a safety management system includes proactive measures to anticipate and prevent or reduce safety risks. Adoption of best practices and continuous safety improvement are overriding goals. A safety management system must be woven into the fabric of the company and become part of the way people do their jobs.

Ahmed (2010) describes a straightforward "basic safety process" for addressing safety issues. First, a safety concern is raised, hazard identified, or a crash or other accident happens, which is then brought to the attention of the manager. The manager and involved employee(s) analyze the issue to determine its sources, which may include both proximal causes and associated risk factors. They then take corrective action. As a follow-up, they evaluate the corrective action to make sure it was effective. If the issue is resolved, it is documented and the corrective action taken so that the safety enhancement is maintained. If the problem or issue is not resolved, they re-analyze it until it is resolved. Figure 14 illustrates the process.

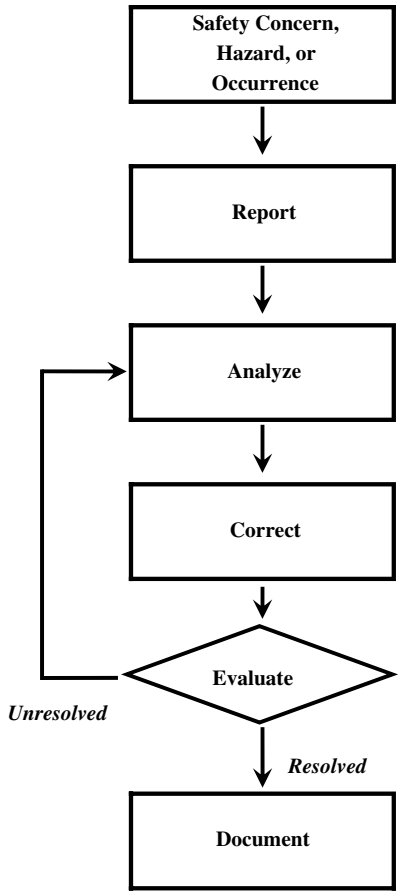


FIGURE 14 Basic process for addressing safety issues. Adapted from Ahmed (2010).

The NTSB annually identifies its "Top Ten Most Wanted" safety improvements. In 2011, NTSB listed transportation safety management systems as one of the top ten needs. Its website states that, "NTSB accident investigations have revealed that, in numerous cases, safety management system (SMS) or system safety programs could have prevented loss of life and injuries" (NTSB 2011). Further, safety management systems ". . . can be effective in all organizations regardless of size."

Transport Canada also promotes safety management systems (Thiffault 2011). In the Canadian Railway Safety Act, a safety management system is defined as "a formal framework for integrating safety into day-to-day operations, which includes safety goals and performance targets, risk assessments, responsibilities and authorities, rules and procedures, and monitoring and evaluation processes." This definition applies to motor carriers as well. Thiffault suggests the following applications of safety management system concepts to small carrier operations:

- *Company commitment.* Company policy statement that safety is critical in all activities and that the company strives to meet or exceed all legal safety standards.
- *Organization and responsibility.* Company policy statement on safety roles of management, drivers, dispatchers, and mechanics.
- *Monitoring and reporting.* Maintain safety data spreadsheet (crashes, violations, incidents, inspections, vehicle problems).
- *Assessment.* Monitor trends in safety performance and take corrective actions.
- *Training.* Informal training during employee meetings and/or short training sessions.
- *Communications.* Manager communicates safety objectives, issues, and plans through meetings and written communications.

### Haddon Matrix

The *Haddon Matrix* (Haddon 1980) is a framework for understanding crash reduction strategies. It provides a conceptual

structure for identifying crash factors by dividing the crash scenario in terms of timeframe (i.e., pre-crash, crash, and post-crash) and in terms of the primary "actors" affecting the event. These actors are the human (primarily driver), the vehicle, and the roadway/environment. As shown in Table 18, the Haddon Matrix is a 3×3 matrix with three rows (pre-crash, crash, and post-crash) and three columns (human, vehicle, and roadway/environment).

The Haddon Matrix is one of the most important concepts in the history of motor vehicle safety (Williams 1999; Runge 2003); however, Will Murray (Murray et al. 2003, 2009) and others (e.g., Faulks and Irwin 2002) have argued that the conventional Haddon Matrix is insufficiently detailed for conceptualizing the full array of crash countermeasures applicable to CMV transport. Most notably, carriers are an important fourth actor and thus could be added as a fourth column. With regard to the timeframes, "pre-crash" actually encompasses several qualitatively different timeframes: pre-trip, pre-threat, and pre-crash impact (recall Figure 9). It is possible to plan schedules, routes, and trips to greatly reduce risks well before crash threats are imminent. Murrays' prescription for carriers is a comprehensive safety program that seeks to proactively identify all important crash factors and establish multiple complementary carrier practices to address them.

Such a systematic approach is more likely to be embraced by larger companies than by smaller ones. Nevertheless, one medium-sized trucking company has been showcased for its adoption of a comprehensive safety management program based on this model. Suckling Transport is a petrochemical transport contractor in the United Kingdom (RoadSafe 2010, 2011). It operates a fleet of 65 articulated tanker trucks. In 2008, it launched its Zero Incident Project, with the goal to eliminate crashes and other accidents entirely. The approach included the following main initiatives:

1. Audit all company safety systems, policies, and procedures.
2. Ensure all aspects of regulatory and traffic law compliance.
3. Improve near-miss and incident reporting by the workforce.
4. Identify technologies and other improvements that could reduce crashes.
5. Improve trip planning.
6. Improve driver training.

When the project started, managers met in focus groups with drivers and other employees to review past crashes, other accidents, and incidents. They analyzed each incident using the Haddon Matrix, with emphasis on pre-accident risk factors that could have been changed. They also looked at company response: both the emergency reaction to the event and at longer-term remediation. Post-event remediation could be directed toward humans (e.g., employee training), the environment (e.g., removal or mitigation of hazards), and/or vehicles (e.g., onboard technologies).

The Zero Incident Project included an audit of company compliance, with continuing monthly updates of performance measures. This has included drug and alcohol testing, driver licensing and medical qualifications, HOS compliance, vehicle speeds, driver mobile phone use, and return-to-work procedures following injuries. Medical qualifications renewals and MVR checks are now performed more frequently than required by law.

The Suckling safety project encompasses both driving and nondriving (e.g., petrochemical handling) safety. Employees are encouraged, and even given incentives, to report incidents and near-misses in addition to actual accidents. "Every accident, near-miss, or potential incident is an opportunity to improve safety," said the company managing director.

Zero Incident Project team members audited every regular delivery route and every customer site to identify risk factors and hazards. They identified travel "Safe Havens" for their drivers; routes deemed the least risky and rest stops (e.g., travel plazas) considered "truck friendly." They also invited their primary customers, major oil companies, to conduct independent, external audits of Suckling operations involving their products.

The project also encompassed the safety of fleet autos. These drivers, mostly managers or technicians, were held to

TABLE 18
HADDON CRASH FACTOR MATRIX AND EXAMPLES

| Actor "/Factor: Timeframe: | Human (Driver) | Vehicle | Roadway/ Environment |
|---|---|---|---|
| Pre-Crash | Driver licensing | Brake, tire condition | Roadway markings |
| | Driver traits | Vehicle safety equipment | Divided highways |
| | Driver training | | Curves |
| Crash | Restraint use | Vehicle size | Guard rails |
| | Bone density | Crashworthiness | Embankments |
| Post-Crash | Victim general health | Gas tank integrity | EMS availability |
| | Rehabilitation | Van/cargo tank integrity | EMS response |

EMS = emergency medical service.

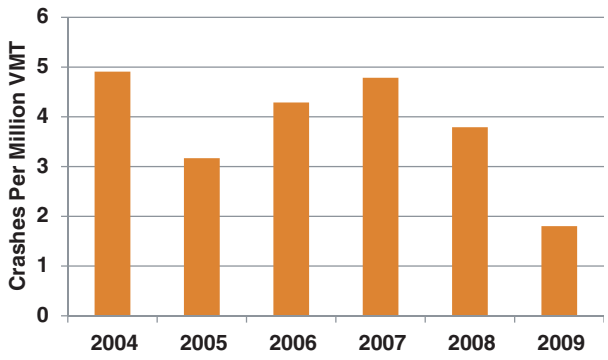


FIGURE 15 Suckling Transport crashes per one million vehicle miles traveled, 2004–2009. *Source:* Suckling Transport (2011).

the same driving standards as company truck drivers. In 2008, Suckling designated a team of six drivers/instructors to monitor vehicle onboard computer data and incidents to determine individual and collective training needs. Employee training is a continuous activity. According to the company, "training is now seen by the workforce as career development, not as punishment" (RoadSafe 2011).

The Zero Incident Project has proven to the company director that "road safety saves money as well as lives" (RoadSafe 2010). Over the course of the project, Suckling Transport has seen significant reductions in crashes, other accidents, employee injuries, and insurance claims. Figures 15 and 16 document Suckling's safety improvements using two metrics. The company director added that, "the benefits of our Zero Incident Project are multiple and include a significant reduction in vehicle downtime, improved fleet and fuel efficiency, a reduction in driver turnover and improved relationships with our customers contributing to new contract wins . . ." In 2010, Suckling Transport was awarded the U.K. Motor Transport Safety in Operation award for its safety and organization development achievements (see Figures 15 and 16).

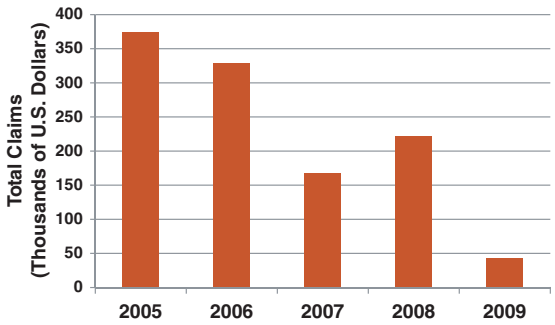


FIGURE 16 Total Suckling Transport insurance claims in thousands of U.S. dollars, 2005–2009. *Source:* Suckling Transport (2011).

### Element Fleet Safety Model

Mooren and her associates at the University of New South Wales in Australia have put forth a 12-element model of company fleet safety as follows (Mooren 2007, 2010):

1. Policy and procedures. Clear statement of safety as a priority combined with defined behavioral expectations.
2. Recruitment. Selection of low-risk drivers.
3. Induction. Ensuring that employees understand the priority placed on safe driving.
4. Safe work planning. Ensuring that work tasks do not compromise driving safety.
5. Fleet selection/maintenance. Equipping and maintaining vehicles that are safe for occupants and other road users.
6. Crash [and incident] reporting. A system to ensure timely and accurate reporting of crashes and other incidents.
7. Data analysis. Rigorous scrutiny and interpretation of crash/incident reports and fleet statistics.
8. Risk resolution. Follow-up interventions to mitigate identified risks.
9. Incentives and sanctions. Rewards or recognition for safe practices and safety results, and sufficient penalties to deter unsafe practices.
10. Driver education. Education and training of drivers on crash risks and how to avoid them.
11. Leadership. Senior managers demonstrate an active and practical commitment to safety
12. Communication. Regular communication within the organization about fleet safety issues.

The Mooren model is based on both theoretical principles (e.g., of behavioral psychology) and past research on motor carrier safety management. At a practical level, the model has been used by companies and their consultants as a structure and "do list" for conducting safety reviews and audits of companies. For example, Mooren and Grzabieta (2010) reviewed the safety management of a dangerous goods (hazardous materials) transport company, first by administering an internal questionnaire on the perceived importance of the 12 elements within the company, and then by investigating perceived gaps. The company implemented many recommendations for safety improvements based on the model and intervention approach.

### Systematic Assessment of Carrier Safety Culture and Climate

Recall from earlier in this chapter that safety culture is defined as the shared values and beliefs within a company that establish safety as a priority and drive company policies and practices. Safety climate, a very similar concept, is a company's collective workforce perceptions of the organizational safety atmosphere (Flin et al. 2000). The U.K. Department for Transport

(DFT 2000) conducted a study of organizational safety culture (and, although the term was not used, safety climate) in transport companies, including small trucking firms. The study investigated the relationship between company safety culture, driver attitudes, and crash risk. The aim of the study was to identify the most important transport company safety culture improvements. The research involved three main phases: (1) manager survey of organizational safety culture, (2) interviews with drivers on their safety attitudes and perceptions of company safety, and (3) collection of company crash and loss data.

The confidential one-hour interviews with drivers addressed their backgrounds and experience, crash and incident involvements, attitudes toward company driving rules and procedures, attitudes about specific driving violations, sources of work pressure, feelings of fatigue, and organizational driving safety management practices. Based on driver responses, company safety culture was assessed in relation to six management areas: driver training, safety rules and procedures, operational planning, incident management and feedback, supervision (e.g., performance monitoring and rewards and discipline), and communications. The work was conceptualized within the framework of the Occupational Road Risk model shown in Figure 17. Although this model was developed with larger transport firms in mind, it nevertheless provides a useful perspective on companies of all sizes. Company policies, perhaps reflective of external influences, become focused areas of safety management, which in turn create various safe conditions within the company and operation. The study safety climate assessment encompassed the six management areas underlined in Figure 17. Driver recruiting and selection, a key area of safety management, was not assessed, perhaps because employees, once hired, do not continue to regularly encounter that management function.

The study found that driver safety attitudes were generally more positive than negative, but that smaller companies tended to be more variable; that is, driver attitudes for a particular company were either predominantly positive or predominantly negative. Larger companies tended to be more uniformly positive. This suggested to the authors that small companies with predominantly negative driver safety attitudes were the companies that would benefit the most from interventions to improve safety management.

The study's collection of company crash and loss data was more successful in larger companies, as smaller companies tended to have poorer documentation and fewer quantitative records. Drivers in small companies might have high judgments of company safety competence, but they reported fewer safety activities such as training, incident reporting, feedback, and guidance. Drivers in small companies rated their fellow drivers more highly than did drivers for larger companies. This

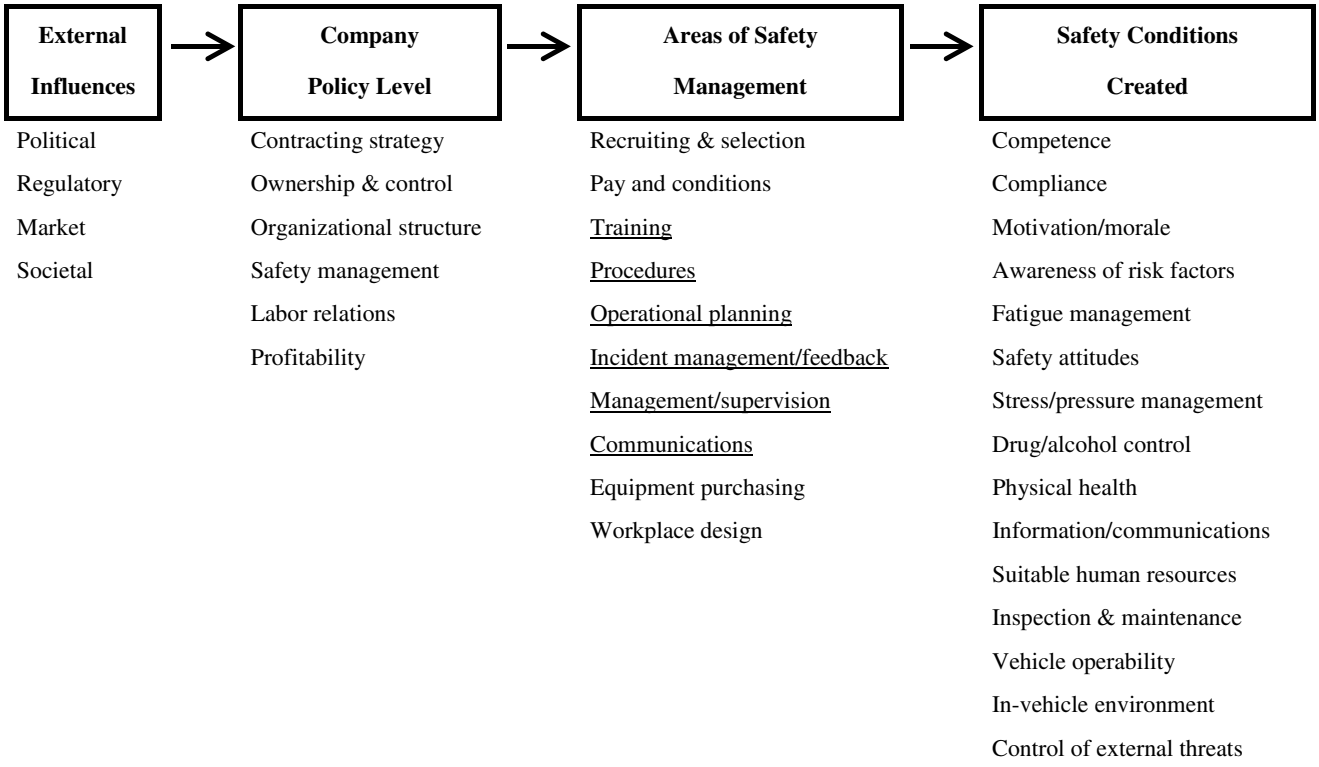


FIGURE 17 Occupational road risk model. Adapted from DFT (2000). Underlined areas of management were included in the study safety climate assessment.

was attributed to closer personal relationships among drivers in smaller companies. In small companies, drivers were more likely to believe that they and their companies were already competent in safety and did not need improvement. Drivers for larger companies reported more safety actions (e.g., training, communications, policies, and consequences) and more receptivity to ongoing safety improvements. In other words, larger companies were more likely to have safety management systems, whereas smaller companies were more likely to simply expect and depend on individual driver competence.

The study included both company truck drivers and company car drivers (e.g., salespersons driving company cars). Truck drivers in the study were generally more safety conscious (e.g., appreciative of driving risks) than were car drivers, and generally had a higher opinion of their fellow truck drivers than car drivers had of fellow car drivers. On the negative side, truck drivers from both small and large companies believed that they often drove under high schedule and productivity pressure.

Based both on the study interviews with truck drivers and a subsequent series of group workshops, priority areas for safety management improvements were operational planning, driver fatigue reduction, and supervision of drivers. Additional priority areas based on workshop discussions included incident management and feedback, driver training, and reduction of work pressure. Two areas not identified as priorities were work procedures and communications. Chapter five presents safety management suggestions for companies from the DFT report.

All four of the frameworks and applications described in this section could be used by companies to systematically assess their safety cultures, climates, and practices. A company could choose to follow one approach that fits its management style and current situation, or it might develop its own hybrid approach. Two important common features of these four approaches are their systematic nature and their willingness to gather new data on safety issues and then initiate new interventions to address them.

CHAPTER FIVE

# CONCLUSIONS AND FURTHER RESEARCH

This report has synthesized information on safety management in small motor carriers (commercial truck and bus companies) in North America. The goals of the study were to (1) identify useful practices for safety management in small companies, and (2) outline a logical and practical progression to more active and comprehensive safety management for small companies as they grow. This chapter summarizes major conclusions relating to project goals and outlines some potential areas for future research and development (R&D) on small carrier management.

Small companies were defined in this study as those with more than one driver, but with too few drivers and trucks to afford to designate a manager with the primary function of "Safety Manager." Further, these are companies where the *company owner/manager drives less than 50% of the time and thus is primarily a manager. He or she performs most management and supervision tasks, including those relating to safety and compliance.* The three principal information sources for this study have been (1) the project survey of small carrier owners/managers, (2) in-depth interviews with a subset of survey respondents, and (3) the research literature review.

This chapter first presents a brief summary and recap of major findings from the project survey. Next, it summarizes findings from all project information sources on small carrier safety performance, safety-related small carrier strengths and advantages, and small carrier safety weaknesses and disadvantages. Then the chapter recounts effective small carrier safety practices identified in the study. Small carriers can progress in safety by adopting more of these practices. Finally, the chapter identifies R&D needs relevant to small carrier safety.

## STUDY SURVEY FINDINGS

The carrier owner/manager survey asked respondents questions about safety problems they faced, what safety management practices they used, and the effectiveness of these practices. Chapter two presented the survey methodology and results in detail. As with most surveys, this one consisted of questions that were either subjective (i.e., asking for an opinion) or were asking for an objective self-report. A more important caveat relates to the sample composition. The respondent sample can be regarded as a convenience and "judgment" sample of interested, knowledgeable individuals, not as a representative sample of some larger population, such as "all small carrier owners/managers." In spite of these caveats, survey findings are revealing because of the comparative information they provide. This includes the perceived relative importance of various safety problems and perceived relative effectiveness of solutions.

A total of 262 respondents (187 truck, 75 bus) completed the online survey; however, the sample reported here was reduced to 112 (79 truck, 33 bus) by Question 34, which asked about the carrier's "functional" size in terms of management. To be included in the current report, respondents had to select multiple choice answer "c," "Company owner/manager. Drives less than 50% of the time. Performs most management and supervision tasks, including safety and compliance."

The first set of questions (1–14) asked about the importance of various small carrier safety management problems. These employed a 5-choice Likert rating scale for importance. The five importance levels were assigned values of 0, 1, 2, 3, and 4 in the data analysis. All of the items received overall average ratings of greater than 2.0 on the 0–4 scale. Therefore, all of the problems were considered to be "important or greater." The highest-rated safety problems included the following (question number in parentheses):

1. Recruiting and selecting good drivers (6).
2. At-risk driving behaviors; for example, speeding and tailgating (2).
3. Assessing driver on-road safety; that is, knowing how safe your drivers are (7).
4. Driver fatigue/drowsiness (3).
5. Correctly rewarding good driver behaviors and disciplining bad behaviors (8).

Problems rated *relatively* unimportant compared with others on the list included lack of training materials for drivers, lack of training materials for managers, and driver personal/family/financial problems.

Questions 15 and 16 presented the seven CSA Behavior Analysis and Safety Improvement Categories (BASICs). Respondents were asked to select the two areas representing the biggest and smallest safety challenges, respectively. For both trucks and buses, the top three items were Fatigued

Driving (HOS compliance), Unsafe Driving, and Vehicle Maintenance.

Questions 17–30 presented 14 assorted carrier practices and first asked respondents to state whether or not they regularly used the practice (yes or no). Respondents used an average of 8 of the 14 practices listed. The most frequently used were preventive maintenance (PM) schedules, providing "EZ Pass" transponders or reimbursing toll charges to drivers, tracking overall company safety statistics, and conducting road and range driving tests with driver applicants. By far the least frequent practice was purchasing advanced vehicle safety systems. Other infrequent practices were using onboard Electronic Onboard Recorders (EOBRs) and having driver applicants complete a questionnaire on attitudes, personality, or driving behaviors.

When a respondent answered "yes" regarding a safety practice, he or she was then presented with a question asking them to rate the effectiveness of the practice on a 5-choice Likert scale. Thus, only users assigned effectiveness ratings. All 14 of the practices received generally high ratings among users; the lowest rating was 2.4 on the 0–4 scale. Safety management practices used by a majority of carrier respondents *and* receiving high favorable ratings included maintaining PM schedules, conducting road and range tests for driver applicants, and participating in peer meetings. Ironically, the three least-used practices all received high average effectiveness ratings from those who used them. These were purchasing advanced vehicle safety systems, use of EOBRs, and use of driver applicant questionnaire on attitudes, personality, or driving behaviors. Across the 14 practices, there was a negative correlation of −0.31 between the percent of respondents using a practice and the average effectiveness value assigned to that practice by users. Perhaps the benefits of common practices are taken for granted, whereas the benefits of less common practices are more readily recognized and appreciated by users.

Questions 31 and 32 listed ten general areas of safety management. In Question 31, respondents were asked to select up to three items they considered most important; that is, having the *greatest effect* on carrier safety outcomes (i.e., crashes, incidents, and violations). In Question 32, they were asked to select up to three items having the *least* effect on carrier safety outcomes. The ten areas are listed here in their order of selection for the truck and bus subsamples combined. The choice letter is in parentheses.

1. Driver selection and hiring (a).
2. Vehicle preventive maintenance (i).
3. Driver training, orientation, and communications (e.g., safety meetings) (b).
4. Driver scheduling and dispatching practices (e).
5. Driver evaluation (i.e., violation and incident tracking, ride-alongs, covert observations of driving, onboard computer monitoring) (c).
6. Trip planning, routing, and navigation (f).
7. Monitoring carrier CSA scores and other safety performance measures (j).
8. Driver performance consequences; that is, rewards and discipline (d).
9. Loading, cargo securement, unloading, and dock/yard practices (g).
10. Vehicle safety equipment (e.g., technologies such as collision avoidance systems) (h).

Item "g" (loading, cargo securement . . .) is much more relevant to truck operations than to bus operations. Nevertheless, it received a relatively low rating in each: ninth for truck respondents and tenth for bus respondents (zero votes).

Several final questions asked for information about respondents' carriers and about themselves. Nearly two-thirds of the carriers were for-hire truckload, and these were roughly split between national and regional. Nearly one-third was charter bus operators. The mean number of carrier vehicles was 10.1, whereas the median value was 7. Most respondents had decades of experience; they had been owners/managers for an average of 17.8 years, and in the commercial motor vehicle (CMV) transport industry for an average of 24.8 years.

## SMALL CARRIER SAFETY PERFORMANCE, ADVANTAGES, AND DISADVANTAGES

Stating generalizations about the safety performance of small carriers in relation to larger ones is problematic. An individual carrier's crash and violation rates are reflective of its own individual practices and operating environment, independent of carrier size. Federal roadside inspection data are not based on random samples; rather, inspections target higher-risk carriers of all sizes through the use of the Inspection Selection System. CSA (Compliance, Safety, Accountability) crash and moving violation metrics are indexed to the number of carrier power units, not carrier mileage. Other factors being equal, a long-haul carrier or driver will look worse on these metrics than those traveling fewer miles. In addition, the CSA Crash History metric does not distinguish between preventable and nonpreventable crashes.

Given these strong caveats, it still appears likely that smaller carriers have higher frequencies of inspection violations than larger carriers. Recent federal data show both driver and vehicle out-of-service (OOS) rates for carriers in the 2–19 vehicle carrier size category to be more than 50% higher than those for carriers in the 100+ vehicle category (see chapter four, Figure 5). A less recent (2001) study by Stock reviewed 13 different measures of compliance in roadside inspections for seven different carrier size categories. Consistent inverse relationships between carrier size and violation frequency were seen in this study. The same study found that smaller carriers tended to be less knowledgeable and hold negative views about U.S. regulations and enforcement practices. As noted, these compliance studies have

weaknesses, and it is also not clear the extent to which small carrier compliance problems translate directly into greater crash risks. This study reviewed available statistics on these issues, but did not include resources to perform new analyses of national statistics. Any statistical study of carrier safety performance by size must control for the concept that safety performance variability is inherently inversely related to carrier size. Smaller carriers have fewer safety data points (i.e., inspections, violations, crashes, exposure) and thus their incidence is more affected by chance variation. This also means that they will have proportionally more extreme outcomes. This is a statistical effect, independent of actual safety risk.

Through the project survey, interviews, and literature reviews it is possible to qualitatively identify apparent safety advantages and strengths small carriers have, as well as apparent disadvantages and weaknesses. The safety advantages and strengths of small carriers over larger ones include the following:

1. **Direct manager contact with drivers and vehicles.** Most small carrier owner/managers personally select their drivers and typically are in direct daily contact. They usually have insight into how well drivers are performing and the problems they might be facing. Similarly, most small company managers know everything about their vehicles. They often perform vehicle maintenance and vehicle inspection tasks themselves, or oversee this work directly. There are no layers in their management structures.
2. **Narrower span of control.** Carriers in this study had an average of ten vehicles and a similar number of drivers. This is a narrower span of control than would be found in a larger fleet, permitting greater individual attention to drivers and vehicles.
3. **Greater personal involvement in company and work.** Both managers' and employees' sense of personal involvement and their work satisfaction are generally greater in small companies and work units than in larger companies and work units.
4. **Lower turnover.** With few exceptions, driver turnover rates are inversely related to company size (see chapter four, "Retention"). Retention and safety are positively related for multiple reasons; one tends to foster the other.
5. **Experienced managers and drivers.** The average survey respondent in this study had 25 years of experience in the industry and 18 years as an owner/manager. Lower driver turnover in small companies means that many drivers are experienced. Many small carriers are family businesses; their owners and drivers may have grown up around trucks and buses.
6. **Niche orientation.** Many successful small companies fill a specific market niche, which gives their managers and workers greater knowledge and experience in their specialization area. They can better anticipate hazards within these unique environments.
7. **Lower productivity pressures in some companies.** Some small company owners, especially those satisfied with their existing market niche, may be less interested in high productivity and company expansion than in maintaining a steady-state operation. For these companies, work pressure may be less than in larger companies (see chapter four, "Driver Hiring").
8. **Vehicle maintenance orientation.** Motor carriers of all sizes appear to recognize the importance of vehicle maintenance and consider it the foundation of safety. This was seen in the current survey and has been seen also in past CTBSSP Synthesis reports. Company pride in vehicle maintenance may not be a small company *advantage* over larger companies (indeed, the findings cited suggest otherwise), but it is a strength to build on.
9. **Recognition of the importance of driver selection.** The earlier statement on vehicle maintenance applies to driver selection and hiring as well. Carriers of all sizes recognize the paramount importance of hiring the right drivers.

The safety disadvantages and weaknesses of small carriers relative to larger ones include the following:

1. **Management spread thin.** Small carrier managers must fulfill many different roles while responding to constant demands. A risk is that they become spread too thin and are continually occupied addressing immediate concerns rather than thinking and acting proactively.
2. **Weak business skills.** Across all types of businesses, small company owners are often experts in their operational work tasks but unprepared for the rigors of business and financial management.
3. **Nonanalytic management.** Many small company owners have flexible personalities; they are informal, confident, assertive, and adventurous (see chapter four, "Operational Management and Supervision"). These traits may lead to success; however, a downside is that flexible personalities often lack thorough analysis in their decision making; rather, they tend to act on intuition.
4. **Weak documentation.** Small companies tend to be less systematic and thorough in documenting their policies, administrative procedures, financial dealings, operational records, etc. For motor carriers, this may leave them more open to vulnerability to enforcement actions and tort liability.
5. **Unsystematic hiring for "personal fit."** Small companies recognize the importance of driver selection, but they are more likely to hire new employees unsystematically and with fewer formalized steps than are larger companies (see chapter four, "Driver Hiring"). Hiring emphasis is often on "interpersonal fit" rather than on an objective breakdown of job tasks, requirements, and applicant qualifications. Small companies are also more likely to conduct "closed searches" for new employees rather than recruiting widely. Barrett et al.

found that having open, formalized, well-documented hiring procedures helped small companies to hire better workers.

6. **Less time spent on driver training.** Small carriers tend to devote less time to both initial and ongoing driver training than do larger carriers. This is also true of safety meetings with drivers. A reason for this may be that small company managers know their drivers better and have more confidence in their abilities.
7. **Less management development.** In general, small companies are less likely to engage in management training and development than are larger firms. This includes both in-house training and training from outside sources. The survey item, "Lack of training materials (or easy access to them) for yourself as a manager" received one of the lowest average safety importance ratings of those presented. It appears that the relative lack of management development in small carriers is related both to lack of resources and lack of perceived need.
8. **Less computer literacy.** This study did not directly address computer literacy; however, one indicator was the relatively low proportion of small carrier respondents (35 of 111) who used online training programs. This suggests a lower familiarity with online resources than would likely be found in larger companies.
9. **Less use of Onboard Safety Monitoring (OBSM).** As discussed in chapter four, "Driver Valuation," OBSM is probably the most powerful form of driver observation and evaluation. Small carriers use OBSM less than larger companies.
10. **Nonuse of crash avoidance technologies.** Two different questions on the project survey indicated that very few small carrier respondents purchase advanced crash avoidance devices and that they do not appreciate their potential safety and business value.
11. **Less use of internal "leading indicators" of safety.** CSA's Safety Measurement System has gotten the attention of the entire CMV industry. Small carriers in this study do pay close attention to CSA metrics for both their drivers and their companies as a whole. However, use of internal "leading indicators" appears to be less common, extensive, and sophisticated in smaller companies than in larger ones.
12. **Less operational planning to reduce risk.** As was discussed in chapter four, motor carriers can reduce their crash risks considerably through better operational planning. Risk avoidance strategies include reducing empty ("deadhead") trips, minimizing loading and unloading and related delays, maximizing travel on Interstates, avoiding urban traffic, avoiding work zones, optimizing travel times, use of higher productivity vehicles, and team driving. Project survey responses and interviews suggest that small carrier managers do not fully perceive the value of these strategies. They do appreciate the increased risks caused by loading and unloading delays, but have less leverage to reduce the problem with their customers than do larger companies.
13. **Limited financial resources.** Many of the earlier-cited disadvantages and weaknesses are related to small carriers' tight profit margins and uncertain cash flows. They are generally much less able to make proactive safety investments (e.g., new vehicles, onboard technologies, and training) than are larger companies.
14. **More likely to be new entrants.** One reason for greater safety challenges in small companies is that they are more likely to be young companies without years of experience and lessons learned. New entrants have higher violation and crash rates than more experienced carriers. FMCSA has initiated a major program to improve new entrant performance.

## IMPROVING SMALL CARRIER SAFETY MANAGEMENT

The project survey (chapter two), case studies (chapter three), and evidence review (chapter four) suggest many effective safety management practices for small carriers and their owners/managers. A company's progression toward more comprehensive safety management is likely to include adoption of multiple new practices such as those described here. Many small companies already do many of these things, as evidenced by the current survey findings. Furthermore, the value of these practices is not limited to small companies. Given that, it is small carriers that need to assess their current practices and consider possible changes in these areas:

1. **Business plan and attention to business needs.** Companies should have a business plan, ensure that pricing is adequate to sustain the business, and pay close attention to the business aspects of company management. This includes legal issues, licensing, facilities, purchasing and leasing contracts, costing of services, assessing and dealing with competition, advertising, loans and other financing, record keeping, taxes, cash flow, contracts, creating a website, and other areas not directly related to CMV transport.
2. **Record keeping.** Companies benefit from maintaining up-to-date and detailed operational, safety, administrative, and financial records.
3. **Development of business management competencies.** The typical small business owner starts as an expert worker, but must transform himself or herself to become a business person and manager. Business management competencies are needed to complement CMV transport competencies.
4. **Self-insight into management style.** It is important that owners/managers recognize their management styles and personalities and, based on this insight, anticipate positive and negative implications for company success.
5. **Build on small company strengths.** The previous section articulated a number of the potential safety

advantages small companies can have over larger companies. These include direct management contact with drivers and vehicles, closer personal relationships within the company, and lower driver turnover. Small companies need to work to retain these small company values while incorporating the more proactive and systematic practices of larger companies.

6. **Systematic management.** As discussed in chapter four, "Business Operational and Safety Management in Small Companies" (for companies in general) and in "Business Management" (for transport companies), a carrier needs to conceptualize and develop its own top-down safety management system. The system might set out a company's safety policies, define how it identifies safety hazards and controls risks, and provide for goal setting, planning, and measuring performance. A company's top-level safety system concept needs to devolve downward to all company employees. Four different systematic approaches to safety management were described in the section on Business Management, and others were discussed earlier in chapter four. Two particularly useful concepts, in the authors' opinion, are Glendon and Stanton's safety monitoring approach (see Figure 13) and Mooren's 12-element model of company fleet safety described in chapter four.
7. **Occupational Safety and Health Administration (OSHA's) four key elements.** By implementing OSHA's Four Key Elements of Company Occupational Safety and Health Programs (chapter four, "Safety Management"), companies would ensure the following
   a. Management commitment and employee involvement in safety.
   b. Worksite analysis to identify hazards.
   c. Hazard prevention and control; for example, established and enforced procedures.
   d. Safety training for drivers and other employees.
8. **Safety culture.** Companies need to develop their own safety cultures; that is, shared values and beliefs establishing safety as a priority.
9. **Consider onboard safety technologies.** Although few small companies purchase such devices, the safety and business benefits of onboard technologies such as Electronic Stability Control, Forward Collision Warning, and Lane Departure Warning are well-established. At a minimum, small carriers would learn how to obtain engine Electronic Control Module (ECM) readouts to help assess driver behavior patterns.
10. **Recognition of compliance challenges.** Although there may be many imperfections in government regulations and enforcement practices, small companies need to recognize the compliance challenges they face and seek to excel in roadside inspections and other compliance areas relative to their peers.
11. **PM schedules and software.** The practice of maintaining PM schedules and records for each vehicle is well-established. This may be aided by the use of commercial maintenance management software.
12. **Operational and trip planning.** Pre-trip, managers and drivers should schedule trips to avoid high-traffic times and excessive driving during circadian low periods (e.g., 3:00 a.m. to 6:00 a.m.). Once on the road, pre-crash threat avoidance includes route selection to avoid undivided highways, traffic congestion, and work zones.
13. **Detention fees for loading and unloading delays.** Even though small carriers have less leverage in dealing with their customers, they could negotiate detention fees as part of their contracts, and enforce them assertively.
14. **Use EZ Pass or reimburse toll charges.** Drivers who choose to drive on a lower-capacity roadway to avoid paying tolls are usually greatly increasing their crash risks. For both time savings and safety, toll roads are preferable. Carriers need to make it easy for drivers to use toll roads.
15. "**Cradle-to-grave**" **Human Resource Management (HRM).** Driver and other employee HRM is critical for any motor carrier. Cradle-to-grave HRM encompasses best practices in employee recruiting, selection, hiring, orientation, training, supervision, evaluation, retention, and termination. These practices may be even more important for small companies because they can potentially retain their drivers longer.
16. **More formalized driver selection.** Survey respondents identified driver selection and hiring as the most important safety management area, and much other research supports that opinion. Chapter four, "Driver Hiring," presented a number of effective driver hiring practices, based in part on *CTBSSP Synthesis 21.* Small carriers can improve driver selection by using more test and measurement tools (e.g., adding a driver questionnaire) and making a conscious effort to hire based on objective criteria rather than primarily "interpersonal fit." One study found that small companies that formalized their HRM processes (e.g., by documenting job tasks, knowledge, skills, and attitude, and minimum employee qualifications) were more successful in finding better employees than those that did not.
17. **Expanded driver training content.** Small carriers might consider expanding their training of new and experienced drivers to include additional topics, such as those identified in *CTBSSP Synthesis 5* and the section on Driver Orientation, Training, and Communications in chapter four of this report.
18. **Embrace e-learning.** Computer-based and web-based training offers numerous advantages over conventional classroom instruction. Ease of access is the most notable advantage; however, e-learning also appears to result in better and faster learning for many topics. In many ways it is ideally suited for small carriers with limited resources. Small carriers need to seek out and take full advantage of e-learning offerings.

19. **Driver evaluation and feedback.** Feedback (knowledge of results) facilitates performance, but feedback must be based on accurate and timely performance measurements. Small carriers could seek to develop multiple measures of driver safety performance to complement those provided by the CSA BASICs.
20. **Consider OBSM.** Although OBSM technology is beyond the immediate reach of many small carriers, those with the capability might consider using it. As discussed in chapter four, OBSM is potentially the most powerful form of driver evaluation because it direct measures behavior.
21. **Safety rewards program.** Rewards and punishments are an extension of feedback. The most effective carrier programs appear to be those based on Behavior-Based Safety (BBS). BBS emphasizes timely observations of behavior, goal-setting, rewards and recognition for success, and correction of any hazardous situations identified. Group involvement is important to the process. Rewards can be tangible but not be of such high value that they become a source of contention. Rather, they are primarily social reinforcers and might be designed to strengthen group norm-setting and cohesion.
22. **Driver retention.** Driver retention is a strength in many small carriers. Positive and supportive personal relationships between managers and drivers appear to be a key to good retention in small companies. Driver pay is also a factor, especially for older drivers with marketable driving records and job skills.
23. **Crash documentation and investigation.** Crashes are rare events, especially for small carriers with just a few vehicles. Proactive carriers have established, prescribed response practices following a crash or incident. Drivers need to be instructed on procedures and provided with crash reporting forms. Insurance companies often provide assistance in this area.
24. **Regular safety measurement and monitoring.** By regularly monitoring and measuring safety, companies can better understand their sources of risk, respond to them, and continually improve. Comparisons with other companies provide both performance benchmarks and ideas for innovation. The CSA BASICs provide such measurements, but these could be supplemented with internal measures, especially measures of driver behavior.
25. **Development of safety management competencies.** Small companies are less likely to engage in management training and development than are larger firms. Through training and professional contacts with peers, small carrier managers can develop their supervisory skills and increase their knowledge of specific safety-related topics.
26. **Participation in carrier peer consortia.** Case study Carrier I (see chapter three) is a charter bus operator with 15 vehicles. Its manager participates in an idea-sharing carrier consortium organized by the United Motorcoach Association. Participants meet several times annually to discuss all aspects of carrier operations and safety. Carriers within each group are selected so as to be geographically dispersed and not in direct competition with each other. Almost any carrier would benefit from this kind of peer information and idea exchange.
27. **Growth and metamorphosis.** Table 17 in chapter four presented five stages of business development. The growth of a business involves dramatic personal and organizational transformations. A manager's role of providing direct supervision is gradually replaced by a role of delegating, coordinating, oversight, and strategic planning.

Broadly, it is important that small carriers try to sustain and reinforce their advantages while also adopting the more systematic safety management approaches often seen in larger companies. This report has frequently cited findings from the *I-95 Corridor Coalition Coordinated Safety Management Study,* which compared carrier safety practices and outcomes by carrier size. Across almost all measures, Stock found that larger fleets generally had more active and systematic approaches to safety. They also achieve better roadside inspection outcomes. Stock concluded that government inspections and enforcement "should focus on smaller fleets." Just as significantly, he concluded that the "safety management practices of larger fleets adjusted for [the] operational constraints of smaller fleets could provide effective 'best practices' models" for small carriers.

These 27 effective practices were identified based on the current survey, interviews, and literature review. The textbox presents abridged recommendations for U.K. transport companies from a similar study by the U.K. Department for Transport. Many of the suggested practices are the same as those suggested earlier.

**"Recommendations for Companies" by the U.K. Department for Transport (2000)**

- Training/Recruitment
  - Ensure thorough driver assessment during recruitment.
  - Carry out a risk assessment on new employees (e.g., a hazard perception test).
  - Set a 'qualifying period' for less-experienced drivers.
  - Integrate corporate safety messages and driving professionalism into training.
  - Establish and maintain a continuous driver training system.
  - Use in-cab computers to provide feedback and incorporate this feedback into training.
  - Teach self-management to drivers.
  - Include the following in driver training: emergency situations, maintenance, freeway driving, traffic laws, defensive driving, hazard awareness, and equipment knowledge.

- Procedures
  - Set driving safety standards with associated procedures and review them periodically.
  - Run formal risk assessments based on accident tracking.
  - Clearly lay out insurance policies, accident procedures, etc.
  - Set specific driver guidelines around trip times, trip lengths, etc.
  - Set a strict cell phone use policy in accordance with the law.
  - Conduct regular safety checks and audits.
- Planning
  - Match drivers to journeys based on a driver's experience, safety history, training, etc.
  - Involve the drivers in planning optimal routes and sequencing.
  - Build breaks, peak traffic times, and local routes into schedules.
  - Plan routes in advance; avoid busy routes when possible.
  - Ensure sufficient time in yard for safety checks.
  - Balance driver hours for even workloads.
  - Stay away from 'strict timed routing' to avoid added pressure on drivers.
- Incident Management/Feedback
  - Educate employees about the value of sharing incident/accident information.
  - Provide guidance and encourage incident reporting without blame.
  - Be willing to learn from accidents, incidents, and near misses.
  - Emphasize what could be done differently in the future, not what went wrong.
- Safety Communications
  - Talk to an employee directly about a problem, do not communicate through others.
  - Communicate information on external hazards such as weather, roadwork, etc.
  - Focus on driving risk factors; for example, speeding, tailgating, need for breaks, and seatbelts.
  - Put out a newsletter 3 to 4 times per year to update everyone on company safety.
  - Be approachable to talk about safety and act on good suggestions.

## RESEARCH AND DEVELOPMENT NEEDS

Our knowledge of small carrier safety would benefit from additional research. In many cases, this research would seek to validate tentative findings from cited research, but with more rigorous methods. Development efforts could focus on new training programs, software applications, and other aids to small carriers. Suggested R&D includes the following:

1. **More representative study samples.** This report, previous CTBSSP reports, and other oft-cited studies of carrier safety management have been based primarily on successful, safer-than-average carriers. Such carriers are more likely to be active in national CMV transport organizations and conferences, and thus more likely to be reached by researchers. Carrier samples generated through probability-based sampling methods would require greater resources, but would reveal more about the practices of the industry as a whole. Further, such studies could be structured as case-control or parametric comparisons between carrier practices and their safety performance criterion measures. This would reveal more cause-and-effect relationships.
2. **Intervention case studies.** This study's case studies provided snapshots of ten motor carriers and probed the views of their owners/managers. However, none involved the experimental application of new safety management interventions. The previous section identified 27 reported effective safety practices for small carriers. Many of these could be structured as direct interventions and evaluated in small carrier case studies. These could be smaller-scale versions of an intensive carrier case study by Murray et al. in 2009 involving Wolseley, a large U.K.-based heating and plumbing distributor. This comprehensive case study classified dozens of company safety interventions that together reduced the Wolseley crash rate by more than 40% over four years. Ideally, intervention case studies would be structured to follow one or more of the systematic, top-down approaches to safety management reviewed in this report.
3. **Driver selection tool validation in small carrier settings.** *CTBSSP Synthesis 21* reviewed driver selection methods of commercial truck and bus companies. Driver selection relies on tests, measurements, and other assessments of applicants. Testable, safety-relevant driver traits include personality, attitudes, psychomotor performance, medical status and conditions, behavioral history, and mental abilities. *CTBSSP Synthesis 21* cites studies of these factors and tests to assess them, but noted that little data had been collected on commercial drivers. Few studies provided the validation evidence needed to legally and ethically justify the use of a test for hiring commercial drivers. Only larger fleets with more sophisticated HRM departments are likely to conduct test validations. Test validation studies with small carriers would need to aggregate data from multiple carriers to be statistically significant. Such studies, followed by educational outreach to the industry on how to use them, would help improve driver selection in small carriers.
4. **Filtering for crash preventability in CSA Crash History BASIC.** One small carrier saw its CSA Crash History indicator jump from 0% to 44% as a consequence of two nonpreventable crashes. In one crash its truck was rear-ended, whereas in the other its stopped truck was struck by a red light runner. A company safety audit by FMCSA would be necessary for the crashes to be removed from its CSA record. FMCSA

and CSA recognize the need for an analytic filter that would keep clearly nonpreventable crashes from confounding company CSA scores. An effort is underway by FMCSA to develop such a capability. This would be especially beneficial to small carriers because they are more vulnerable to large score shifts based on a small number of crashes.

5. **Control for regression to the mean in Compliance Reviews.** Two studies of pre-CSA Compliance Reviews have reported dramatic carrier size differences in post-review safety outcome changes. Consistently, the magnitude of post-review safety improvements varied inversely with carrier size, suggesting that small carriers are more responsive to these audits. However, the same effect could be the result of regression to the mean, and the two studies did not appear to adequately control for that. Similar studies under the new CSA regimen and with adequate controls could determine the degree to which this suggested safety improvement effect is "real." More broadly, the effort could address the degree to which CSA and other safety measurements are reliable for small carriers. In a 2011 report, U.S. General Accountability Office (GAO) pointed out that a significant majority of small carriers have insufficient BASIC compliance data to be ranked under the CSA Safety Measurement System.
6. **Aid to small carriers in reducing detention delays.** The GAO recently reported that, in a survey, 68% of surveyed drivers had experienced excessive loading and unloading delays in the past month, and that 80% of these drivers reported that the delays affected their ability to meet HOS requirements. The report found that small carrier drivers are more vulnerable to such delays because their companies have less market strength to demand customer compliance with loading and unloading provisions of shipping contracts. A 2011 analysis by Miao et al. estimated the true cost of delay to be $80 to $121 per hour for truck drivers and their carriers. A typical detention charge is $50 per hour, with drivers receiving half of that. Small carriers need assistance in dealing with this source of financial loss and safety risk. One way would be to publish a detailed guide on how carriers can successfully prevent detention delays and receive proper compensation when they are delayed.
7. **Technology demonstrations in small carriers.** Vehicle safety equipment was seen by survey respondents as the least important of ten safety management areas, and only four of 111 survey respondents regularly purchased such devices. However, advanced safety technologies can dramatically reduce crashes. Technology transfer studies could investigate the reasons behind small carriers' resistance to safety technologies and ways to overcome it. Factors examined might include initial costs, returns on investment, effectiveness, system reliability and maintainability, driver acceptance, management use of system data, and potential liability concerns. Field operational tests conducted with groups of small carriers (as opposed to single large carriers) could demonstrate technology practicality and effectiveness. These tests could showcase both the direct crash prevention and OBSM features of safety technologies. An entry-level OBSM approach for small carriers is to take their vehicles to a dealership where they can obtain downloads of driving data from engine ECMs. A demonstration study might familiarize small carriers with this low-cost approach, provide training on how to read and use the data, and provide benchmarking statistics to improve driver safety assessments based on ECM data.
8. **Open-access benchmarking tool.** Small carriers would benefit from a low-cost (or free), open-access safety management benchmarking database. The database would consist of lists of specific safety management practices and internal leading indicators of safety (see chapter four, "Carrier Performance Tracking and Benchmarking"). Carriers could enter their own data into the database and receive feedback on how their practices compare with those of peer companies. Confidentiality would be essential. The *I-95 Corridor Coalition Coordinated Safety Management Study* developed an interactive, web-based "Safety Toolbox" to provide such benchmarking; however, it is no longer active.
9. **Web-based management training for small carriers.** Small company managers are less likely to seek professional training and development than those in larger firms. This reticence is the result of a lack of time, money, and recognition of potential benefits. If well-designed and promoted, low-cost, web-based training for managers could improve small carrier business viability and safety outcomes. Successful web-based training for managers might result in greater use of web-based driver training in small companies as well.
10. **Wellness programs for small carrier drivers.** This study did not explore driver health and wellness issues in depth, and driver health was not considered by small carrier survey respondents to be a top safety problem. Nevertheless, prevailing evidence suggests that unhealthy lifestyles and associated medical conditions are significantly more common for CMV drivers than for the rest of the U.S. adult population. Many larger, progressive companies have initiated driver wellness programs; however, they are less common among smaller companies. Small carriers would benefit from assistance in this area.

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# ACRONYMS

| Acronym | Term |
|---|---|
| ABA | American Bus Association |
| ATA | American Trucking Associations |
| ATRI | American Transportation Research Institute |
| BISC | Bus Industry Safety Council |
| CDL | Commercial Drivers License |
| CFR | Code of Federal Regulations |
| CMV | Commercial motor vehicle |
| CR | Critical Reason |
| CSA | Compliance, Safety, Accountability |
| DOL | Department of Labor |
| DOT | Department of Transportation (federal, unless otherwise specified) |
| ECM | Electronic Control Module |
| FMCSR | Federal Motor Carrier Safety Regulation |
| HOS | Hours-of-service |
| HR | Human Resources |
| IIHS | Insurance Institute for Highway Safety |
| KSAs | Knowledge(s), skills, and attitudes |
| LOC | Locus of control |
| LTCCS | Large Truck Crash Causation Study |
| LTL | Less-than truckload |
| MVR | Motor vehicle record |
| nAch | Need for achievement |
| NASTC | National Association of Small Trucking Companies |
| NIOSH | National Institute for Occupational Safety & Health |
| NPTC | National Private Truck Council |
| OBSM | On-Board Safety Monitoring |
| OO | Owner–Operator |
| OOIDA | Owner–Operators Independent Drivers Association |
| OOS | Out-of-service |
| OSA | Obstructive Sleep Apnea |
| PAR | Police Accident Report |
| PM | Preventive maintenance |
| PSP | Pre-Employment Screening Program |
| R&D | Research & Development |
| ROI | Return on Investment |
| SMS | Safety management system |
| ST | Single-Unit Truck (Straight Truck) |
| SV | Single-Vehicle [crash] |
| TC | Transport Canada |
| TCA | Truckload Carriers Association |
| TL | Truckload |
| TRIS | Transportation Research Information Services |
| *TT* | *Transport Topics* (publication) |
| UMA | United Motorcoach Association |
| UMM | University of Minnesota at Morris |
| UMTRI | University of Michigan Transportation Research Institute |
| VMT | Vehicle-miles traveled |
| VTTI | Virginia Tech Transportation Institute |

# GLOSSARY

**Assessment**—Any test or procedure used to measure an individual's employment or career-related qualifications or characteristics (DOL 2000).

**Associated factors** [e.g., in the Large Truck Crash Causation Study (LTCCS)]—Human, vehicle, or environmental conditions present at the time of the crash. Associated factors are not direct crash causes, but are often viewed as contributing factors.

**Behavior-Based Safety (BBS)**—The application of behavioral principles to industrial safety. Combines applied behavior analysis, behavior modification, quality management, organization development, and risk management.

**Benchmarking**—To compare company practices and outcomes with those of other carriers (external benchmarking), or to track them in relation to past performance or to goals (internal benchmarking).

**Correlation**—The degree of association or predictability between two variables (e.g., height and weight) among the same group of subjects (e.g., drivers).

**Correlation coefficient**—A statistic summarizing direction and degree of association. Correlation coefficients range from −1.0 (a perfect *inverse* relation) through zero (no statistical association) to +1.0 (a perfect *linear* relation).

**Criterion**—Any measure of work behavior or any outcome that can be used as the standard for successful job performance. Relevant examples include driver crash rate, violation rate, tenure with company, or supervisory ratings of performance as a driver.

**Critical Reason (CR)**—In the LTCCS, the human, vehicle, or environmental failure leading to the Critical Event and thus to the crash. Simplistically, it is the immediate or proximal cause of a crash.

**Detention**—Loading and unloading delays beyond contract terms.

**Differential driver risk**—Enduring individual differences among drivers in crash risk. Related to various personal traits such as age, personality, character, medical conditions, other physical variations, and performance capabilities.

**Diversion**—Truck drivers or other motorists choosing smaller roads rather than toll roads to avoid paying the tolls.

**E-learning**—Web-based and computer-based instruction, usually involving multi-media interactive individual instruction.

**Exposure**—Vehicle-miles traveled (VMT), hours driving, or other denominator to determine crash rates. Exposure data are essential for determining relative risk for different drivers, vehicle types, and driving situations.

**Feedback Principle**—Knowledge of results consistently facilitates learning and performance improvement. Applies to almost any kind of performance.

**Haddon Matrix**—Framework for understanding crash and injury reduction strategies, consisting of three time periods (pre-crash, crash, post-crash) and three "actors" (human, vehicle, environment).

**Job analysis**—Defining and describing a job in terms of the behaviors necessary to perform it. This includes job tasks and knowledge, skills, and attitudes [knowledge, skills, and attitudes (KSAs)] necessary for successful performance.

**Leading indicators**—Measures of employee attitudes, behaviors, or incidents that might be predictive of future safety outcomes (lagging indicators).

**Law of Reinforcement and Punishment (Law of Effect)**—Behaviors that are rewarded will continue and likely increase in frequency, whereas those that are punished will generally decrease in frequency.

**Likert scale**—Common survey technique in that answer choices are presented as numeric rating scales, often with five choices numbered from 1 to 5.

**Regression to the mean**—In statistics, the phenomenon that, if a variable is extreme on its first measurement, it will tend to be closer to the average on its second measurement (Everitt 2002). Experimental studies of extreme groups (e.g., very poor performing carriers receiving Compliance Reviews) should control for regression to the mean.

**Response bias**—The tendency, likely strong in the current surveys, for respondents to be more committed and interested in the topic than those not responding. Because of response bias and other factors, the surveys in this project should not be considered representative of larger groups (e.g., all motor carrier safety managers).

**Risk avoidance**—As used in this report, planning and conducting operations in ways that minimize exposure to crash risk. For example, planning trips to avoid urban traffic and undivided highways.

**Risk factor**—Any prior factor—driver, vehicle, environmental, carrier—that affects the probability of a crash.

**Safety culture**—Shared values and beliefs within an organization that establish safety as a priority and drive organization policies and practices.

**Safety climate**—Employee perception of a company's organizational atmosphere with regard to safety.

**Safety management system (SMS)**—Plan setting out a company's safety policies, defining how it identifies safety hazards and controls risks, and providing for goal setting, planning, and measuring performance.

# APPENDIX A
# Survey Form Text

**[Actual survey was administered online.]**

**MANAGER SURVEY: STUDY ON SAFETY MANAGEMENT IN SMALL MOTOR CARRIERS**
**Transportation Research Board CTBSSP Synthesis Study MC-25**

Dear Motor Carrier Owner/Manager,

The Transportation Research Board (TRB) is conducting a synthesis study on *Safety Management in Small Motor Carriers*. This is being done under the TRB Commercial Truck and Bus Safety Synthesis Program (CTBSSP).
The project seeks to identify useful practices for safety management in small companies and help small companies improve their safety performance.

This survey is being sent to trucking and bus company owners/managers. It will take about 20 minutes to complete. Your participation is greatly appreciated, and we hope you will find the questions to be interesting.

Participation in the survey is **voluntary**. All answers are **confidential** and will be aggregated with other responses in the reporting. No survey comments or other responses will be attributed to an individual. Answer only those questions you wish to answer.

If you have any questions or wish to provide additional information or materials, please contact the study manager at tbsafety@aol.com.

**Importance of Various Safety Management Problems**
Items 1–14 present various safety management problems you may face. Rate the importance of each problem. Extremely important items are those with the strongest relation to crash risk, and requiring your greatest attention. If you have no opinion, leave it blank and move on to the next question.

| Safety Problem: | Not Important | Somewhat Important | Important | Very Important | Extremely Important |
|---|---|---|---|---|---|
| **(1)** Lack of basic driving skills among your drivers | **1** | **2** | **3** | **4** | **5** |
| **(2)** At-risk driving behaviors (e.g., speeding, tailgating) | **1** | **2** | **3** | **4** | **5** |
| **(3)** Driver fatigue/drowsiness | **1** | **2** | **3** | **4** | **5** |
| **(4)** Driver health, wellness, and nutrition problems | **1** | **2** | **3** | **4** | **5** |
| **(5)** Driver personal, family, and financial problems | **1** | **2** | **3** | **4** | **5** |
| **(6)** Recruiting and selecting good drivers | **1** | **2** | **3** | **4** | **5** |
| **(7)** Assessing driver on-road safety (i.e., knowing how safe your drivers are) | **1** | **2** | **3** | **4** | **5** |
| **(8)** Correctly rewarding good driver behaviors and disciplining bad behaviors | **1** | **2** | **3** | **4** | **5** |
| **(9)** Driver turnover resulting in an unstable workforce | **1** | **2** | **3** | **4** | **5** |
| **(10)** Delays associated with loading and unloading cargo | **1** | **2** | **3** | **4** | **5** |
| **(11)** Non-driving injuries and other accidents (e.g., slips and falls, cargo-related) | **1** | **2** | **3** | **4** | **5** |

| | | | | | |
|---|---|---|---|---|---|
| **(12)** Not enough management time to adequately address all safety problems and issues | **1** | **2** | **3** | **4** | **5** |
| **(13)** Lack of training materials (or easy access to them) or drivers | **1** | **2** | **3** | **4** | **5** |
| **(14)** Lack of training materials (or easy access to them) for yourself as a manager | **1** | **2** | **3** | **4** | **5** |

**CSA (Compliance, Safety, Accountability) Compliance Challenges**

**(15)** In the CSA, there are seven Behavior Analysis and Safety Improvement Categories (BASICs). Which **two** BASIC are are the ***biggest compliance challenges*** for your company. In other words, the areas where compliance is most difficult? If you are not sure, leave the answer blank.

a) UNSAFE DRIVING—speeding, reckless driving, improper lane change, inattention
b) FATIGUED DRIVING—HOS, logbook violations
c) DRIVER FITNESS—missing CDLs, medical qualifications
d) ALCOHOL, DRUGS—impairment by alcohol, drugs, or medications
e) VEHICLE MAINTENANCE—failure to make repairs; adjust brakes, etc.
f) CARGO SECUREMENT—shifting, spilled, dropped cargo, size-weight violations, unsafe hazmat handling
g) CRASH HISTORY—frequency, severity of DOT-defined crashes.

**(16)** Which **two** BASIC areas are the ***smallest*** compliance challenges for your company. In other words, the areas where compliance is easiest?

a) UNSAFE DRIVING—speeding, reckless driving, improper lane change, inattention
b) FATIGUED DRIVING—HOS, logbook violations
c) DRIVER FITNESS—missing CDLs, medical qualifications
d) ALCOHOL, DRUGS—impairment by alcohol, illegal drugs, prescription, or over-the-counter medications
e) VEHICLE MAINTENANCE—failure to make repairs; brakes, lights, other mechanical defects
f) CARGO SECUREMENT—shifting, spilled, dropped cargo, size-weight violations, unsafe hazmat handling
g) CRASH HISTORY—frequency, severity of DOT-defined crashes.

**Which Operational Practices Do You Regularly Use?**

For each of the operational practices below, please indicate **yes** or **no** whether your organization uses the practice. If **yes**, rate its overall **safety effectiveness** using the 1–5 scale provided. If **no**, leave the ratings blank.

| **Carrier Practices:** | **Do you regularly use?** | | **If "Yes," please rate safety effectiveness:** | | | | |
|---|---|---|---|---|---|---|---|
| | | | **Highly Ineffective** | **Ineffective** | **Not Sure/ Neutral** | **Effective** | **Highly Effective** |
| **(17)** Conduct road and range driving tests with all driver applicants | **Yes** | **No** | **1** | **2** | **3** | **4** | **5** |
| **(18)** Have driver applicants complete questionnaire on attitudes, personality, or driving behaviors | **Yes** | **No** | **1** | **2** | **3** | **4** | **5** |
| **(19)** Conduct regularly scheduled safety meetings with drivers | **Yes** | **No** | **1** | **2** | **3** | **4** | **5** |
| **(20)** Give drivers bonuses or other rewards for safe driving | **Yes** | **No** | **1** | **2** | **3** | **4** | **5** |
| **(21)** Use online web-based training programs for drivers, other employees, or yourself | **Yes** | **No** | **1** | **2** | **3** | **4** | **5** |
| **(22)** Use training media in-house (e.g., DVDs, PowerPoint presentations) | **Yes** | **No** | **1** | **2** | **3** | **4** | **5** |
| **(23)** Use Electronic Onboard Recorders (EOBRs) | **Yes** | **No** | **1** | **2** | **3** | **4** | **5** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **(24)** Monitor individual driver fuel economy | **Yes** | **No** | **1** | **2** | **3** | **4** | **5** |
| **(25)** Purchase advanced vehicle safety systems (forward collision warning, lane departure warning, electronic stability control, onboard computers to monitor driving, etc.) | **Yes** | **No** | **1** | **2** | **3** | **4** | **5** |
| **(26)** Maintain preventive maintenance (PM) schedule and record for each vehicle | **Yes** | **No** | **1** | **2** | **3** | **4** | **5** |
| **(27)** Charge extra fees to customers for excessive loading/unloading delays | **Yes** | **No** | **1** | **2** | **3** | **4** | **5** |
| **(28)** Reimburse toll charges to drivers and/or provide ”EZ Pass” transponders | **Yes** | **No** | **1** | **2** | **3** | **4** | **5** |
| **(29)** Track overall company safety statistics (e.g., crash and violation rates, financial losses from crashes) | **Yes** | **No** | **1** | **2** | **3** | **4** | **5** |
| **(30)** Participate in formal or informal meetings with your peers; e.g., truck or bus association meetings or other gatherings | **Yes** | **No** | **1** | **2** | **3** | **4** | **5** |

**Important Areas of Safety Management**

**(31)** All areas of carrier safety management are important, but some may be more important than others. Pick **up to three (3)** of the following carrier safety management areas which, in your opinion, have the ***greatest effect*** on carrier safety outcomes (i.e., crashes, incidents, and violations).

(a) Driver selection and hiring
(b) Driver training, orientation, and communications (e.g., safety meetings)
(c) Driver evaluation (i.e., violation and incident tracking, ride-alongs, covert observations of driving, onboard computer monitoring)
(d) Driver performance consequences; i.e., rewards and discipline
(e) Driver scheduling and dispatching practices
(f) Trip planning, routing, and navigation
(g) Loading, cargo securement, unloading, and dock/yard practices
(h) Vehicle safety equipment (e.g., technologies such as collision avoidance systems)
(i) Vehicle preventive maintenance
(j) Monitoring carrier CSA scores and other safety performance measures

**(32)** Although all carrier safety management areas can be important, some may be **less** important than others. Pick **up to three (3)** of the following carrier safety management areas which, in your opinion, have the ***least effect*** on carrier safety outcomes (i.e., crashes, incidents, and violations).

(a) Driver selection and hiring
(b) Driver training, orientation, and communications (e.g., safety meetings)
(c) Driver evaluation (i.e., violation and incident tracking, ride-alongs, covert observations of driving, onboard computer monitoring)
(d) Driver performance consequences; i.e., rewards and discipline
(e) Driver scheduling and dispatching practices

(f) Trip planning, routing, and navigation
(g) Loading, cargo securement, unloading, and dock/yard practices
(h) Vehicle safety equipment (e.g., technologies such as collision avoidance systems)
(i) Vehicle preventive maintenance
(j) Monitoring carrier CSA scores and other safety performance measures

**(33) Other comments** regarding safety management in small carriers:

**Information about You and Your Fleet**

**(34)** Which best describes you and your company?

(a) Solo owner–operator (i.e., you are the only driver)
(b) Driver (drives 50% or more of the time), but also operates other vehicles and employs other drivers
(c) Company owner/manager. Drives less than 50% of the time. Performs most management and supervision tasks, including safety and compliance
(d) Owner/manager of company large enough to have multiple managers, including a designated manager of safety and/or compliance
(e) Other: _____.

**(35)** How many NON-DRIVER employees do you have? Do not count yourself.
(a) 0 (b) 1 (c) 2 (d) 3 (e) 4 or more

**(36)** Number of years you have been a carrier owner/manager: _____
**(37)** Your total years experience in commercial truck/bus operations: _____
**(38)** Number of power units in your fleet: _____
**(39)** Circle *the **operation type** that best characterizes your fleet:*
**(a)** Truck for hire: long haul/truckload, national
**(b)** Truck for hire: long-haul/truckload, regional
**(c)** Truck for hire: local/short haul (most trips <100 miles)
**(d)** Truck private industry: long haul, national or regional
**(e)** Truck private: local/short haul (most trips <100 miles)
**(f)** Passenger carrier: scheduled service
**(g)** Passenger carrier: charter
**(h)** Other: _____

**(40)** Provide your e-mail address if you would like to receive pdfs of the project report and presentation in early 2011.

This information will be used for no other purpose. _____

**(41)** A few survey respondents will be asked to participate in a follow-up phone interview to discuss innovative fleet safety practices. Responses will be confidential; interviewees or carriers will not be identified unless desired. You would be paid $50 for a 45-minute interview, scheduled at your convenience. If you are potentially interested, please provide your name, e-mail address, and daytime phone: _____.

***Thank you for completing this survey!***
[Questions or additional comments? E-mail the project manager at tbsafety@aol.com]

Abbreviations used without definitions in TRB publications:

| | |
|---|---|
| AAAE | American Association of Airport Executives |
| AASHO | American Association of State Highway Officials |
| AASHTO | American Association of State Highway and Transportation Officials |
| ACI–NA | Airports Council International–North America |
| ACRP | Airport Cooperative Research Program |
| ADA | Americans with Disabilities Act |
| 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 | Air Transport Association |
| ATA | American Trucking Associations |
| CTAA | Community Transportation Association of America |
| CTBSSP | Commercial Truck and Bus Safety Synthesis Program |
| DHS | Department of Homeland Security |
| DOE | Department of Energy |
| EPA | Environmental Protection Agency |
| FAA | Federal Aviation Administration |
| FHWA | Federal Highway Administration |
| FMCSA | Federal Motor Carrier Safety Administration |
| FRA | Federal Railroad Administration |
| FTA | Federal Transit Administration |
| HMCRP | Hazardous Materials Cooperative Research Program |
| IEEE | Institute of Electrical and Electronics Engineers |
| ISTEA | Intermodal Surface Transportation Efficiency Act of 1991 |
| ITE | Institute of Transportation Engineers |
| NASA | National Aeronautics and Space Administration |
| NASAO | National Association of State Aviation Officials |
| NCFRP | National Cooperative Freight Research Program |
| NCHRP | National Cooperative Highway Research Program |
| NHTSA | National Highway Traffic Safety Administration |
| NTSB | National Transportation Safety Board |
| PHMSA | Pipeline and Hazardous Materials Safety Administration |
| RITA | Research and Innovative Technology Administration |
| SAE | Society of Automotive Engineers |
| SAFETEA-LU | Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005) |
| TCRP | Transit Cooperative Research Program |
| TEA-21 | Transportation Equity Act for the 21st Century (1998) |
| TRB | Transportation Research Board |
| TSA | Transportation Security Administration |
| U.S.DOT | United States Department of Transportation |