Commercial Truck and Bus Safety

Synthesis 8

Commercial Motor Vehicle Driver Safety Belt Usage

A Synthesis of Safety Practice

Sponsored by the
Federal Motor Carrier
Safety Administration

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

COMMERCIAL TRUCK AND BUS SAFETY SYNTHESIS PROGRAM

Synthesis 8

Commercial Motor Vehicle Driver Safety Belt Usage

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Operations and Safety • Public Transit • Freight Transportation

Research Sponsored by the Federal Motor Carrier Safety Administration

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WASHINGTON, D.C.
2005
www.TRB.org

COMMERCIAL TRUCK AND BUS SAFETY SYNTHESIS PROGRAM

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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).

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

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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 8

Project MC-08

ISSN 1544-6808

ISBN 0-309-08827-5

Library of Congress Control Number 2005927129

Price $16.00

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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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Published reports of the

COMMERCIAL TRUCK AND BUS SAFETY SYNTHESIS PROGRAM

are available from:

Transportation Research Board
Business Office
500 Fifth Street, NW
Washington, DC 20001

and can be ordered through the Internet at:
http://www.national-academies.org/trb/bookstore

Printed in the United States of America

Note: The Transportation Research Board of the National Academies, the National Research Council, and the Federal Motor Carrier Safety Administration do not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the object of this report.

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FOREWORD

By Christopher W. Jenks
CTBSSP Manager
Transportation Research Board

This synthesis will be useful to commercial vehicle operators, federal and state agencies, and others interested in improving commercial vehicle safety. The report identifies and documents (1) motivating factors that influence commercial motor vehicle (CMV) drivers in deciding whether to wear safety belts and (2) research and practices that address CMV safety belt usage. It also offers a review of ergonomic and human engineering factors in the design and use of safety belts in CMVs as well as approaches to facilitate safety belt use by truck manufacturers. The information for this synthesis was obtained through a review of relevant literature; a survey of commercial truck and bus fleet managers; focus group discussions with CMV drivers; a survey of CMV drivers conducted at several truck stops; a review of the interactions of the commonly used 3-point safety belt with a range of CMV drivers; and visits to a number of CMV original equipment manufacturers (OEMs) to examine installation of current safety belt designs and approaches used in new CMVs. This synthesis was prepared in support of the U.S. Department of Transportation Federal Motor Carrier Safety Administration's Commercial Motor Vehicle Safety Belt Partnership, which is conducting outreach activities to promote safety belt use and participating in and implementing safety belt-related research.

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.

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COMMERCIAL MOTOR VEHICLE DRIVER SAFETY BELT USAGE

SUMMARY

This synthesis focuses on (1) the motivating factors that influence commercial motor vehicle (CMV) drivers in deciding whether to wear safety belts and (2) research and suggested practices that address CMV safety belt usage. The Federal Motor Carrier Safety Administration (FMCSA) is keenly interested in efforts that will yield increased safety belt usage. This synthesis supports this FMCSA interest and its goals to increase safety belt usage.

The initial step in this research project was a summary of available information in the safety literature and in other sources on the factors that influence CMV drivers to use or not to use safety belts in their daily operations, including a special focus on driver motivational factors. The literature review identified and annotated past and current ongoing research on safety belt use by CMV drivers, not only in the United States, but in other countries as well (Australia and the United Kingdom are key examples).

Much of the additional information on CMV driver motivations relating to safety belt usage was collected through two surveys. The first focused on fleet managers, gauging their approaches and policies relating to safety belt use by their drivers. The second effort focused on the drivers themselves and was gathered through interviews at truck stops and through more structured group interviews.

The fleet manager survey included 120 respondents, based both on mail distribution and collection at meetings of trucking industry associations. This survey consisted of 36 questions, including general questions and questions relating to fleet methods to promote safety belt use, government/industry programs to promote use, general comments, and demographic questions. The fleet manager survey results are explained in detail in Chapter 4. The managers listed the following major reasons their drivers might not use safety belts:

1. Too much trouble and effort
2. Just forget
3. Habit
4. Belt does not fit well
5. Uncomfortable for other reasons
6. Restricts movement in vehicle

7. Infringes on personal freedom
8. Worried about being trapped in vehicle
9. Don't believe belts increase safety
10. Just don't like them
11. Part-time users; e.g., only in bad weather

With respect to methods that fleet managers used to promote use, the three top-rated methods were rewards/recognition for observed use, observing driver belt use in vehicles, and punishments/reprimands for non-use. Other methods were also identified, and there were indications that fleet managers used multiple approaches to encourage drivers to use safety belts. The highest rated method involving industry and government programs was showing crash testing with test dummies with and without safety belts.

The principal driver survey, involving 238 respondents, was a structured interview conducted at two truck stop locations, one in Georgia and one in Wisconsin. The on-site random interviews were based on an interview guide that contained 18 questions, including general questions and questions about safety belt functionality, carrier/driver interactions, and trucking and driver demographics. The detailed results of these interviews are presented in Chapter 5. The interview population indicated that the substantial majority wore safety belts all or most of the time. They chose to wear a belt primarily because of safety, because it was the law, it was a habit, or they had seen or been in an accident. For those who did not choose to wear a belt, the primary reason related to comfort, personal choice, or dislike. For those drivers who felt that truck safety belts should be more functional, they listed the following issues relating to functionality:

1. Limited range of arm and shoulder motion
2. Lap belt or shoulder harness is not long enough/too tight
3. Shoulder harness position is awkward
4. Belts ride too high or too low

Some 62% of drivers did have complaints about safety belts. The major complaints were as follows:

1. Safety belt rubs or vibrates against neck/shoulder
2. Safety belt locks
3. Safety belt is uncomfortable
4. Safety belt is too tight
5. Safety belt has limited range of motion

The major reasons drivers gave that would make a safety belt easy to use were that it should not be too tight, not interfere with driving, be easy to put on and take off, and be easy to position. With respect to carrier and fleet interactions, most drivers who responded to these questions indicated that there is no penalty for non-use, and there are no special incentives that would encourage them to use safety belts.

Chapter 6 of this synthesis reviews the results of two focus groups held with a number of drivers in group settings. These results were similar in many respects to those of the driver interviews and also included general questions and questions about functionality and carrier/driver interactions.

The regulatory framework relating to safety belt use by CMV drivers is set out in Chapter 3.

A review of ergonomic and human engineering factors in design and use or non-use of safety belts in commercial trucks as well as approaches to facilitating safety belt use

by truck manufacturers is included in Chapter 7. The research team ergonomist examined the interactions of generally used 3-point safety belts with a range of drivers and in different types of truck cabs. The research team also visited original equipment manufacturers (OEMs) to examine installation of current seat and safety belt designs and to study differing approaches used in new large trucks. In general, the assessment was that the majority of safety belts were practical and functional and that newer belts had features that made them even more user-friendly. However, current belts were not as comfortable or effective with large- or small-statured individuals. Also the assessment found that many drivers observed were not fully aware of the features that made belts both comfortable and easy to use. The assessment also included additional ergonomics and human factors considerations such as ride quality and comfort and interaction of air-ride seats with safety belts. New technologies for safety belt comfort and user-friendly design were also discussed.

Chapter 8 contains general conclusions of the synthesis, including a discussion of the suggested practice techniques used by transportation managers—especially fleet managers—to encourage and potentially enforce safety belt usage as a part of fleet management safety operations. These practices were drawn from the literature review and responses to the fleet manager and driver surveys. These suggested practices include improved educational and motivational efforts on the part of fleet managers to increase safety belt usage and to use or install those belts which have comfort and ease of use features.

Chapter 8 also presents recommendations relating to potential research to further improve knowledge on motivational factors affecting safety belt usage.

Throughout the conduct of this study, the research team coordinated its efforts with the Commercial Motor Vehicle Safety Belt Partnership (the Partnership) to ensure that surveys and activities were consistent with the work of the Partnership, especially in the area of surveys and research activities.

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Although FMCSA requires use of safety belts by commercial motor vehicle (CMV) drivers, research cited by FMCSA showed that less than one-half of these CMV drivers actually used safety belts.

In 2003, FMCSA completed a study of CMV safety belt usage, conducted by the Center for Applied Research, Inc. The study estimated an overall safety belt usage of 48%. Large national fleets averaged a usage rate of 54%. The rate for independent and local fleets was estimated to be 44%. These usage rates compare with a national usage rate of 79% for passenger car drivers.

In February 2005, a Central Missouri State University study of safety belt use in Missouri reported a use rate of 58.8% based on 15,440 observations at 250 sites throughout the state (Depue 2004). Although higher than the FMCSA study, these rates still fall well below the passenger car rate.

The FMCSA also reports that, in 2002, of the 588 CMV drivers killed in crashes, more than one-half were not wearing safety belts. Of those drivers ejected from their trucks, 80% were not wearing safety belts. Other countries such as Australia and the United Kingdom have experienced similar results and have undertaken programs to encourage CMV drivers to wear safety belts as a part of their daily operating practices.

As a part of its goal to reduce fatal truck involved accidents by 2008 to 1.65 fatalities per 100 million truck vehicle miles traveled, FMCSA is seeking to increase safety belt use among CMV drivers. To this end, in December 2003, the U.S. Department of Transportation (USDOT) announced that it had established the Commercial Motor Vehicle Safety Belt Partnership (the Partnership). The Partnership is planning to conduct outreach activities promoting safety belt use and participate in and implement safety belt-related research.

FMCSA initiated this research project so that it could learn about motivating factors that influence CMV drivers in deciding whether to wear safety belts and about any research and best practices that address safety belt usage. FMCSA is also interested in ongoing surveys to determine the effectiveness of efforts to increase safety belt usage. This synthesis was specifically designed to support this FMCSA interest and its goals to increase safety belt usage.

1.2 SCOPE

Appendix A contains the Statement of Work (SOW) for the research project. According to this SOW, this research project focused on five principal objectives.

First, the research team summarized available information in the safety literature and in other sources on the factors that influenced CMV drivers to use or not to use safety belts in their daily operations. This information included a special focus on driver motivational factors. The literature review identified and annotated past and current ongoing research on safety belt use by CMV drivers, not only in the United States, but in other countries as well (Australia and the United Kingdom were key examples).

Second, the research team identified motivational factors affecting safety belt usage through surveys of fleet managers and drivers and structured interviews conducted through cooperating associations.

Third, the research team explored documented accounts and other research to isolate unsolved problems and other factors that have limited CMV safety belt usage. This exploration included a review of ergonomic and human engineering factors in design and use or non-use of safety belts in commercial trucks, as well as approaches to facilitating safety belt use by truck manufacturers.

The fourth component of the research project was a discussion of techniques used by transportation managers—especially fleet managers—to encourage and potentially enforce safety belt usage as a part of fleet management safety operations. These practices were gathered from the literature review and responses to the fleet manager and driver surveys. This component also included a description of the regulatory framework that has influenced safety belt use.

Finally, the research team developed recommendations for additional research to improve knowledge on motivational factors affecting safety belt usage.

Throughout the conduct of this study, the research team coordinated its efforts with the Partnership to ensure that surveys and activities were consistent with the work of the Partnership, especially in the area of surveys and research activities.

1.3 APPROACH

Information on factors affecting CMV driver safety belt use was obtained through several major approaches. The ini-

tial effort was a review of the literature that encompassed the following:

- CMV safety research, both in the United States and in other countries.
- Motivational research in related fields.
- Company practices and approaches to documenting and encouraging safety belt usage.
- Industrial and transportation safety management in other than CMV transport modes, including commercial and public bus and transit modes.

The literature review also included a review of the efforts and success of the National Highway Traffic Safety Administration's (NHTSA) earlier initiative to increase safety belt use by passenger car drivers. Although factors relating to safety belt use by CMV drivers and passenger car drivers could be different in some respects, the information in the NHTSA effort provided a baseline and starting point for this research project.

The primary means for obtaining information for this research project were surveys. Two parallel survey forms were employed: (a) one for CMV fleet managers and (b) one for CMV drivers. The surveys included both objective and subjective questions. For example, there were objective questions asking fleet managers about their particular safety management practices relating to safety belts. Subjective questions addressed the reasons some drivers did not wear safety belts and the relationship between non-belt use and other risky behaviors. Both objective and subjective questions have value, but the distinction between them should be kept in mind.

The surveys included yes-no, multiple choice, and 5-point scale items. The survey forms also included basic information on respondents and their carriers.

The fleet manager survey was distributed primarily by U.S. Mail using a Virginia Tech Transportation Institute mailing list of fleet managers who had responded to previous surveys. Other fleet manager respondents were identified in conjunction with the American Transportation Research Institute (ATRI). Survey forms were also distributed with the assistance of industry trade associations.

Surveys of CMV drivers were also conducted. The format of the survey questionnaire was similar to that of the fleet manager form, and many of the questions were similar. However, these questions focused on the individual driver's own attitudes and behavior. The distribution of these questionnaires to drivers was primarily through the efforts of ATRI, which conducted surveys at truck stops. Additionally, the research team conducted several interviews at an industry event and at a fleet location.

Survey responses are found in Chapter 4 for fleet managers and in Chapter 5 for CMV drivers.

To focus on ergonomic and physical issues relating to safety belt use, the research team canvassed truck manufacturers to identify and summarize technological approaches to dealing with barriers to safety belt usage. The staff of the Truck Manufacturers Association (TMA) was especially helpful in this effort.

Drawing from the literature review, surveys, and analysis of ergonomic factors, the research team summarized the principal factors and presented these to help guide the Partnership in planning and implementing outreach efforts to encourage increased safety belt use by CMV drivers.

The synthesis concludes with recommendations for research and development (R&D) that might be performed to further improve knowledge and enable development of practices that will increase safety belt usage.

Appendices to the synthesis include the SOW for this research project, the fleet manager survey form, the CMV driver interview guide, the driver focus group interview guide, and an overview of NHTSA's passenger car safety belt campaign.

CHAPTER 2

PRINCIPAL FINDINGS FROM THE LITERATURE REVIEW

2.1 OVERVIEW

This chapter presents the principal findings of a review of traffic safety literature on motivational factors relating to CMV driver safety belt use. The review included literature from the United States and other countries. Materials were obtained through a series of online searches of the Transportation Research Information System (TRIS) and other internet resources. In addition, this section includes several documents obtained directly from FMCSA that, in some cases, have not been publicly distributed.

Sections in this chapter include research on safety belt use by CMV drivers, motivational factors for safety belt usage among CMV drivers and the general driving population, behavior-based safety (BBS) research, safety belt comfort and usability, driver demographics, and the effects of legislation on driver behavior.

2.2 GENERAL RESEARCH ON SAFETY BELT USE BY CMV DRIVERS

This section highlights three U.S. projects that analyzed usage based on field observations, one synthesis of an Australian study, and one 5-year study based on data from France.

2.2.1 U.S. Studies on Safety Belt Usage

Chapter 3 of this synthesis is based on data collected through structured interviews of truck drivers at truck stops. This method relies heavily on the reliability of driver self-reporting.

Direct interaction with CMV drivers is not the only method to measure their behavior. In three U.S. studies, the research team found researchers based their findings on observed behavior rather than on direct collection of data through driver interaction. CMV driver safety belt use was based on whether the shoulder harness was visible to the observer (i.e., if it was visible, the driver was wearing the safety belt).

A study of Alaskan safety belt use (Hanna 2003) compared rates of safety belt use among automobile drivers and their passengers with truck drivers and their passengers. In this study, observers measured shoulder harness use on highway and surface street locations and found that 83% of car drivers wore their safety belts, while 71% of truck drivers wore theirs. This same study determined passenger use at 67% among truck passengers and 79% among car passengers. It should be noted that most commercial vehicles, especially those that are truckload and not making local deliveries, have only one occupant.

Knoblauch et al. (2003) used a similar method to determine the rate of safety belt use among CMV drivers. They conducted a study of Class 7 and 8 trucks at 12 sites for 2-day periods using visual observations of shoulder harnesses as an indicator of safety belt use. Site selection was first determined through a 'probability proportional to size' method, which led to the selection of 12 states. Step two determined county groups with more than 300 highway miles within each state, and the third step determined observation locations within those counties. The population size observed, 3,909 trucks, resulted in a reported final safety belt usage rate of 48%. Those vehicles hauling trailers with HazMat placards were operated by persons wearing safety belts 67% of the time, drawing a possible correlation between the additional training required to be a HazMat vehicle operator and the attention to safety by the operator.

In a recent TRB submittal, Kim and Tremblay (2004) discussed observational research of safety belt use and the dilemma posed by vehicles that had only lap belts. The authors noted that it was legal for commercial vehicles manufactured before a certain year to have only a lap belt. In the Kim and Tremblay study, and in studies where safety belt use was observed, it was assumed that if a harness was not seen across the driver, then that driver was not wearing a safety belt. It was then assumed that if a harness was not visible (whether on or off the driver), then the vehicle must have had only a lap belt. Of those drivers who were assumed to have only a lap belt, it was assumed they were wearing their safety belts at the same rates as those who had a visible harness. However, there might have been differences the research did not address, such as perceived safety benefit from the use of a lap belt, increased comfort due to the lack of a shoulder harness, and driver demographics for those who operate older vehicles.

2.2.2 Australian Study

In a study that looked at reasons for driver behavior and safety belt effectiveness, Preece (2002) synthesized the results

of several Australian studies that examined the rate at which truck drivers and passengers used safety belts, the reasons that decisions were made to use a safety belt, and the actual value of safety belt use for heavy truck drivers and passengers. The research concluded that drivers believed that safety belts were dangerous to use and could be made more comfortable. Note that these same attitudes were present in the driver interviews.

Furthermore, understanding that a need for increased safety belt use among CMV drivers was necessary, the study recommended providing information about the safety benefits of safety belt use to the drivers, encouraging truck owners to equip vehicles with proper safety belt systems, informing drivers of the legal reasons for wearing a safety belt, and finally, increasing enforcement of current safety belt-related regulations.

2.2.3 French Study

To understand the relationship between level of injury and safety belt use, accident victims were studied in trauma rooms over a 5-year period in the Rhone region of France (Charbotel 2003). It was found that drivers of trucks were more likely to be seriously injured than their car-driving counterparts. The research found a statistical ratio of 1.87 for truck operators receiving severe injuries, compared with automobile drivers, in similar crashes. Researchers placed blame for this higher rate and scope of injury on the lack of safety belt use by truck drivers. The research thus highlights the problem of low use rates of safety belts among truck drivers and the potential harm of not wearing a safety belt when driving a truck.

2.3 DRIVER MOTIVATIONAL FACTORS AND INCENTIVES FOR SAFETY BELT USE

The provision of incentives for both private and CMV drivers to wear safety belts has been studied extensively, and the research has found that those who chose to wear their safety belts did so for a number of reasons. As documented in Chapter 5, safety, laws, and family all played a role in why users chose to wear a safety belt regularly. But when drivers were partial users or strong non-users, the latter reasons did not appear to play a role in increasing safety practices such as safety belt usage. Incentives, however, have been shown to, at the very least, influence drivers in the short term to wear safety belts.

Geller, Paterson, and Talbott (1982) described a situation where college staff, students, and faculty were offered contingent and non-contingent rewards for safety belt use and found that only those rewards that were contingent on safety belt use significantly impacted behavior, though both rewards had a message regarding the use of safety belts. Thus, it appears to be important that safety belt use relate directly to the incentive for the practice to be effective.

A similar study by Geller (Dec. 1982) offered employees of a munitions plant an opportunity to win a prize contingent on safety belt use. Geller found that safety belt use more than doubled during the incentive treatment, but fell back to previous levels during a follow-up. These two studies appear to indicate that quick, one-time incentives do not contribute to long-term safety belt use.

In a series of case studies and recommendations, Geller (Oct. 1982) described incentive types for use by employers with a goal of influencing safety belt use among employees. An emphasis was placed on incentives, rather than disincentives, with discussion of incentive types including direct and immediate rewards, direct and delayed rewards, and indirect rewards.

The long-term effects of employer programs designed to increase safety belt use were explored in Geller et al. (1987). They reviewed 28 different programs at nine separate occupational settings that targeted safety belt use. Four categories were determined within the nine settings: those that offered direct and immediate rewards, those with direct and delayed rewards, those with indirect and delayed rewards, and those that offered no rewards. Several conclusions were drawn:

- **Amount of participant involvement elicited by the intervention.** Smaller discussion groups elicited more participation per participant. Thus, try to keep discussion groups fairly small to elicit more active driver involvement.
- **Degree of social support promoted by the intervention.** Social support was usually affected by the degree of active peer, friend, and family involvement. If possible, try to involve family members and coworkers as much as possible; they can be a valuable source of motivation and support.
- **Amount of specific response information transmitted by the intervention.** In other words, be specific and explain intervention components and new behavioral knowledge clearly and carefully.
- **Degree of extrinsic control exerted by the interventions (i.e., incentives and disincentives).** Try to manage the use of incentives and disincentives and only use them if other approaches have failed.
- **Individual's perception of autonomy or self-control regarding the behavior change procedures.** Autonomy was increased by the perception of intrinsic control and freedom of choice. Thus, allowing employees to choose their own safety-related goals and other intervention components will increase feelings of empowerment and self-control.

More recently, the effects of incentives tools as a motivational factor in increasing safety belt use was explored by Hagenzieker, Bijleveld, and Davidse (1997). The study team conducted a meta-analysis of research publications regarding the use of incentives for safety belt use. Two coders

analyzed a total of 139 articles each (this includes duplicate articles) during their research. The final synthesis of these articles resulted in a differentiation between the short- and long-term effects of incentive tools. As might be expected, there were found to be substantial increases in usage of safety belts during the immediate time after an incentive was offered and/or received. Long-term effects, however, did not show the same results. During follow-up surveys of incentive programs, there was still found to be an overall increase in safety belt use from the use rates before the incentive program.

Finally, Herbal and Skopatz discuss the literature of and practices for motivating safety belt use. More specifically, their research focused on two areas, the first was an examination of employer influence on employee safety behavior (regardless of regulatory efforts), and the second was a review of programs produced to help employers increase safety among their employees. They concluded that there were many motivating factors that could be used to compel employees to use safety belts, but none stood out as the 'best practice' method.

2.4 BEHAVIOR-BASED SAFETY

Assuming that safety belt use can help prevent death and reduce the severity of injuries that result during crashes, the literature on safety practices suggests that BBS practices offer a workplace an approach to positively reinforce desired behavior. A detailed discussion of BBS in a commercial vehicle safety setting can be found in *CTBSSP Synthesis 1* (Knipling, Hickman, and Bergoffen 2003).

White and Washington (2001) found that enforcement intensity was positively correlated with safety belt use. When enforcement covered a greater area however (lane miles of enforcement coverage) safety belt use declined. Safety belt use was also higher in urban areas than in rural areas. These findings were consistent with the other research that indicated that safety belt use for strong non-users was reduced when drivers did not think they were being observed or their risk of 'being caught' is lower. It should be noted that a desire for greater enforcement was indicated as something that would increase safety belt use by CMV drivers who were interviewed by this research team.

A study of taxicab drivers, who are often exempt from safety belt laws, found that use rates were typically lower for these drivers than for the general population. When strong laws that did apply to them were put into place, safety belt use increased dramatically among cab drivers. The study suggests that a 'punishment'/disincentive may be very effective in increasing safety belt use, where fear of losing a license may be the necessary incentive to use safety belts (Ferguson et al. 1999).

Other studies have found that while any type of program had some effect on increasing safety belt use rates, law and incentive programs produced the highest increase in use (Johnston, Hendricks, and Fike 1994). This again supports the work done by Geller and others indicating that incentives and stronger enforcement techniques are most effective.

Research conducted by Boyce and Geller (1999) on what is termed a multiple intervention level (MIL) hierarchy found that there was a modest increase in safety belt use with the promise-card commitment strategy (a driver signs a card committing to future safety belt use) combined with an incentive/rewards strategy. The study overall indicated that repeated attempts to change behavior using similar interventions (those with the same level of intrusiveness) were not as effective at changing behavior which was unaffected by the first application of the intervention. It is therefore necessary to progressively use more intrusive interventions if the initial attempts are not effective.

Some recent research in the United States (Shults et al. 2004) has indicated that states that directly enacted primary laws (in which the driver is penalized for non-use) demonstrated more safety belt use than those that relied on secondary laws (in which the driver can only be penalized for non-use after a moving violation is witnessed).

International studies have found that when individuals were personally prompted to wear safety belts they were more likely to do so than when more methods, other than personally focused methods, were used (Gras et al. 2003). Studies conducted in Greece indicated that similar issues manifested themselves when the non-use of safety belts was studied. In particular, the study by Chliaoutakis et al. (2000) found that while legal requirements increased safety belt use, discomfort and miles traveled reduced safety belt use.

A study of incentive programs and enforcement on military bases in the Netherlands found that enforcement was a more accepted countermeasure than rewarding drivers for safety belt use. However, the caveat is that participants who were receiving the incentive treatment had a more positive opinion of this program than those who were exposed to the enforcement treatment (Hagenzieker 1992).

A research study in Canada found that safety belt non-use was most common among drivers who (1) were younger and male, (2) had high-risk health habits (e.g., drinking and driving), (3) were speeding, (4) were smoking, (5) were living in rural regions, and (6) had lower education levels (Sahai et al. 1998).

2.5 RESEARCH ON SAFETY BELT COMFORT AND USABILITY

The literature indicated that discomfort was one reason some CMV drivers did not wear safety belts. Specific reasons included harness belt rubbing (especially when complicated by vibrations), tightness or looseness, and lack of mobility. Though many drivers indicated that the effectiveness of the safety belt would be decreased if changes were made, there was still a desire for a system that had greater levels of comfort.

In one study, an attempt was made to improve seat design methods and processes and to capture the effects of seat dynamics on ride quality. Hix, Ziemba, and Schoof (2000) suggested that since air suspension seats used in trucks isolated a significant amount of the road vibration, it was critical the seats be designed so that the driver experienced a good ride from the seat. Hix et al. evaluated two different seats: (1) a typical North American air-ride seat which had thick-soft foam, a parallelogram vertical suspension, and a pendulum type fore/aft isolator and (2) a typical European seat which had thin-firm foam, a scissor-type vertical suspension, and a spring-type fore/aft isolator.

To accomplish a thorough modeling of truck seats, Hix et al. accounted for numerous measurements of several obvious seat components (seat cushions, riser base, air springs, shocks, shock absorbers, fore-aft isolators, nuts, bolts, bearings, etc.) and of a number of seat design features (including vertical performance and fore/aft compliance). As part of their project, Hix et al. also chose to evaluate safety belt comfort. They did their physical tests on a 5-degree of freedom seat-shaker table, upon which they measured such characteristics of seats as accelerations, displacements, forces such as force-deflection splines (stiffness), and constant damping coefficients (for vibration attenuation).

Hix et al. intended that the forces measured validate comfort variables of the full occupant restraint systems (safety belts). However, their work in taking measurements of both seats found the forces to be small; and the safety belt retractors they tested never experienced "lock-up." They concluded the safety belts did not have any adverse effects on comfort during any of their normal test ride (shaker table) events. Therefore, Hix et al.'s seat models did not include the entire restraint system, including the retractors (Hix et al. 2000).

In 2001, Balci, Vertz, and Shen conducted a questionnaire survey regarding safety belt comfort and usability. Significant findings in this survey indicated that five problems were persistent among automobile drivers. This research showed first that two of these issues were (1) that the safety belt was difficult to negotiate with clothes and (2) that the belt would get caught in the door. These were not found to be common complaints among those CMV drivers who answered the research team's questionnaire. Three other complaints, belt twisting, belt lock-up, and difficulty locating the buckle, were as common to this research project as they were to the Balci study.

2.6 DRIVER DEMOGRAPHICS

A self-reported data study focusing on potential impacts of driver demographic characteristics (Shinar, Schechtman, and Compton 2001) found through its analysis that observing speed limits, not drinking and driving, and wearing a safety belt were safety behaviors that were entirely independent of one another. Furthermore, the study found—contrary to certain stereotypes—that income, education, and age were not determinants of safety behaviors. The only predictor found was that female drivers are more likely to follow all three safety components of this study.

2.7 EFFECT OF LAWS

Cohen and Einar (2001) concluded that safety belt laws applying to all drivers did lead to an increase in safety belt usage, and thus an increase in lives saved. It also drew a comparison between primary and secondary state safety belt laws. The researchers concluded through their analysis that if all states moved toward a primary enforcement policy, national rates of safety belt use would increase 9% to 77% and 500 lives would be saved annually.

2.8 OVERVIEW OF AUTO SAFETY BELT PROGRAM

The research team also considered the significance of the efforts and success of the NHTSA's earlier initiative to increase safety belt use by automobile drivers. Although factors relating to safety belt use by CMV and passenger car drivers are different in some respects, the information about the NHTSA effort can provide a baseline and starting point for future efforts to promote increased CMV driver safety belt use.

A detailed report of the NHTSA program is included as Appendix E of this synthesis. It outlines the phases and programs associated with increases in safety belt use from 1978 to 2003. The appendix describes the approaches used to increase safety belt use, including public information, education, incentives and rewards, requirements (laws), and enforcement.

CHAPTER **3**

REGULATORY FRAMEWORK

Federal regulations and most states clearly require the use of safety belts by CMV drivers. Federal law requires that trucks and truck tractors manufactured on or after January 1, 1965, be equipped with a safety belt assembly meeting requirements specified in federal regulations.

The specific federal requirements are set out in the Code of Federal Regulations (CFRs), as follows:

> **49 CFR 392.16 Use of seat belts.**
>
> *A commercial motor vehicle which has a seat belt assembly installed at the driver's seat shall not be driven unless the driver has properly restrained himself / herself with the seat belt assembly.*
>
> **49 CFR 393.93 Seats, seat belt assemblies, and seat belt assembly anchorages.**
>
> (b) *Trucks and truck tractors—*
>
> (b)(1) *Trucks and truck tractors manufactured on and after January 1, 1965, and before July 1, 1971.* Except as provided in paragraph (d) of this section, after June 30, 1972, every truck and truck tractor manufactured on or after January 1, 1965, and before July 1, 1971, must be equipped with a Type 1 or Type 2 seat belt assembly that conforms to Federal Motor Vehicle Safety Standard No. 209 (§ 571.209) installed at the driver's seat and at the right front outboard seat, if the vehicle has one, and seat belt assembly anchorages that conform to the location and geometric requirements of Federal Motor Vehicle Safety Standard No. 210 (§ 571.210) for each seat belt assembly that is required by this subparagraph.
>
> (b)(2) *Trucks and truck tractors manufactured on or after July 1, 1971.* Every truck and truck tractor manufactured on or after July 1, 1971, except a truck or truck tractor being transported in driveaway-towaway operation and having an incomplete vehicle seating and cab configuration, must conform to the requirements of Federal Motor Vehicle Safety Standard No. 208-1 (§ 571.208) (relating to installation of seat belt assemblies) and Federal Motor Vehicle Safety Standard No. 210-1 (§ 571.210) (relating to installation of seat belt assembly anchorages).

While the federal regulations are clear, the degree to which this provision of the regulations is enforced by states varies from one state to another according to their unique laws, policies, and procedures. There is significant variance in the level of enforcement of safety belt violations found during roadside inspections. Additionally, the number of tickets written by states varies widely.

Some states adopt the Federal Motor Carrier Safety Regulations (FMCSR) administratively, which effectively makes those regulations enforceable as state law, whether or not the state has a primary or secondary safety belt law. Other states have motor carrier safety laws and regulations compatible with the FMCSR that include a safety belt provision.

State and local motor carrier officers—those certified to conduct Commercial Vehicle Safety Alliance (CVSA) inspections—are authorized to write a safety belt violation on a CMV inspection report, whether they write an enforcement citation for this violation or not. FMCSA officials indicate that while non-motor carrier officers can write a citation for safety belt violations pursuant to state law (subject to the complications mentioned previously), they may not write that violation on an inspection report unless they are certified to conduct a motor carrier inspection.

An FMCSA agent may write a safety belt violation on an inspection report and has authority to take enforcement action for such violations in interstate commerce. However, there are significant complications with FMCSA taking enforcement action against drivers for these violations resulting from roadside inspections. Unlike the states, FMCSA does not have a simple way to issue citations or tickets. The agency issues claim letters and is required to take into consideration several factors to calculate the penalty before the agency determines the penalty amount.

The enforcement issue is highlighted in a recent FMCSA report titled, *MCMIS (Motor Carrier Management Information System) Safety Belt (392.16) Violations Cited During Inspections Conducted from Jan 1, 2003 to Dec 31, 2003.* The report indicated that 52,000 safety belt violations out of close to 3 million inspections were recorded. An average of 1.8% does not appear to be consistent with other study results that indicate only 48% of CMV drivers wear their safety belts. In percentage terms, the number of citations ranged from a low of 0.3% in the District of Columbia, South Dakota, and Wyoming to a high of 7.5% in Massachusetts.

Finally, the regulatory area cannot be fully understood without an appreciation of the difference between primary and secondary state enforcement laws. As defined by the NHTSA, these are as follows:

- **Primary Enforcement** allows a law enforcement officer to stop a vehicle and issue a citation when the officer observes an unbelted driver or passenger.
- **Secondary Enforcement** means that a citation for not wearing a safety belt can only be written after the officer stops the vehicle or cites the offender for another infraction.

At last count (January 2004), 20 states, the District of Columbia, and Puerto Rico had primary safety belt laws in effect. Twenty-nine states had secondary enforcement laws and one state (New Hampshire) had no adult safety belt use law. In 2003, the average safety belt use rate in states with primary enforcement laws, as reported by NHTSA, was 8 percentage points higher than in states without primary enforcement.

CHAPTER 4

FLEET MANAGER SURVEYS

4.1 SURVEY METHODOLOGY

A survey was used to obtain data from 120 fleet managers on driver safety belt use and ways to increase use. The fleet manager survey form can be found in Appendix B. This section describes the methodology behind the survey in greater detail, and the next section provides the principal results.

A general consideration regarding most of the survey responses is that they represent subjective responses to subjective questions. A few questions were objective (e.g., asking fleet managers whether or not they used a safety belt promotion practice), but most called for subjective judgments or estimates by respondents. This group was highly qualified to render such judgments, however, so the surveys could be said to capture expert opinion, particularly in regard to fleet management practices.

4.1.1 Survey Distribution and Analysis

Survey forms were distributed in two principal ways. First, they were distributed by mail, with each form accompanied by a cover letter and a stamped envelope addressed to project personnel at the Virginia Tech Transportation Institute (VTTI). Recipients were primarily respondents from previous CTBSSP synthesis studies for whom contact information was available. Second, many survey forms (with attached cover letter) were distributed through the safety councils or at safety meetings of trucking industry associations. This included the National Private Truck Council, American Trucking Associations, Missouri Trucking Association, Georgia Motor Trucking Association, and Minnesota Trucking Association. In addition, surveys were distributed to fleet manager attendees of fatigue management training sessions co-sponsored by the ATA and state associations, including the Oregon Trucking Association, Washington Trucking Association, and Ohio Trucking Association.

The fleet manager respondent sample is best considered as a convenience sample. Study resources did not permit the design of a systematic subject sampling and survey distribution process or the tracking of survey return rates for various respondent groups. Moreover, those who complete and return a survey of this nature are likely to be those most interested in the topic of safety belts and most committed to the promotion of their use. The research team considers the current sample of survey respondents to consist primarily of safety conscious fleet managers.

As with most surveys, not all respondents answered all the questions. In this analysis, the response percentages reported were based on the total that answered the question.

4.1.2 Survey Design and Content

The fleet manager survey form contained 36 questions and was divided into five parts:

- **Part 1: General Questions.** This first part contained fill-in and multiple choice questions to ascertain use of safety belts as well as possible reasons for non-use.
- **Part 2: Fleet Methods to Promote Use.** This part listed different fleet methods to promote use. There were two-part questions. The first part asked fleet managers to answer "yes" or "no" in relation to their own fleet methods. The instructions then stated, "If 'yes,' then rate your perception of the level of effectiveness in promoting belt use by circling the appropriate number." The ratings for all questions were based on the same 5-point (0 to 4) scale.
- **Part 3: Government/Industry Programs to Promote Use.** Respondents were asked to rate the effectiveness of each government/industry program listed using a 5-point (0 to 4) scale.
- **Part 4: Comments.** Fleet managers were asked for any comments on CMV driver safety belt use and ways to promote it. Several lines of space were provided for these comments. Some of the comments are cited in the synthesis.
- **Part 5: Information about You and Your Fleet.** This final part contained questions about years of experience and fleet size and operation type.

4.2 PRINCIPAL SURVEY RESULTS

4.2.1 Part 1: General Questions

The first several questions of this survey were written to assess fleet managers' own use of safety belts and to have them estimate percentages of safety belt usage for their fleet and for all U.S. CMV drivers. The first question was a two-part question asking fleet managers how often they wore

safety belts both at work (work vehicle type not specified) and in their private vehicle. Seventy-eight percent (78%) of fleet managers said they always wore safety belts at work while 80% said that they always wore their safety belt in their private vehicle (see Table 1). As noted previously, this percentage should not be interpreted as representing all U.S. fleet managers, but rather managers who are generally more safety conscious than the average.

Fleet manager respondents averaged 63% in their estimation of what percentage of all U.S. CMV drivers wore safety belts, versus 80% in their estimation of the percentage of safety belt usage among their own fleet's drivers. In other words, they generally considered their fleet drivers to have higher safety belt usage rates than CMV drivers in general. Indeed, only five of the respondents (4.2%) thought that their drivers had a lower usage rate than all CMV drivers. Twenty of the respondents (16.6%) thought that the usage rates for their drivers and all drivers were the same. The other 95 respondents (79.2%) thought that their drivers had higher usage rates than CMV drivers in general. Additionally, 81.0% of the respondents knew that federal regulations required CMV drivers to wear safety belts while on the job.

Respondents were also given a list of 12 possible reasons for not wearing safety belts and asked to select up to three choices for reasons that drivers in their fleet do not wear safety belts. Respondents could also select the choice that this question was not applicable to their fleets. Table 2 provides these results. Slightly more than one-quarter of the respondents rated "worried about being trapped in vehicle" as a reason their fleet drivers did not wear safety belts. Several other reasons were commonly cited also. The percentages totaled more than 100% because respondents could select up to three reasons.

The final question in Part 1 had respondents consider the drivers in their fleet who did not wear safety belts regularly. They were asked whether these drivers, compared with other drivers, tended to engage more often in unsafe driving practices and violations of company regulations and rules. The fleet managers could respond "yes," "no," or "not sure." Among those who answered the question, the percentages were as follows:

- Yes: 20.2%
- No: 38.4%
- Not sure: 41.4%

The high percentage of "not sure" answers to the above question perhaps proves the difficulty of answering the question based on the limited information managers may have on which of their drivers wear or do not wear safety belts, and how much this behavior correlates with other safety behaviors.

TABLE 1 Fleet manager personal safety belt usage

PERSONAL SAFETY BELT USAGE	At Work	Private Vehicle
Never	1%	0%
Rarely	4%	3%
About half the time	4%	3%
Usually	13%	14%
Always	78%	80%

TABLE 2 Possible reasons for not using safety belts

POSSIBLE REASONS	% of Managers Citing Reason
Too much trouble and effort	21%
Just forget	25%
Habit	23%
Belt does not fit well	18%
Uncomfortable for other reasons	25%
Restricts movement in vehicle	23%
Infringement on personal freedom	11%
Worried about being trapped in vehicle	26%
They don't believe belts increase safety	14%
Just don't like them	23%
Part-time users; e.g., only in bad weather	15%
Frequently getting in and out of cab	24%
N/A. All of our drivers always wear safety belts	10%

Note: Totals more than 100% because respondents could select multiple (up to 3) reasons.

4.2.2 Part 2: Fleet Methods to Promote Use

Fleet manager respondents were given a list of 19 possible fleet methods to promote safety belt use. They were asked to circle "yes" or "no" for each method to indicate whether or not the method was used in their fleet. If they circled "yes," they were asked to rate that method for its effectiveness using a 5-point scale. The scale went from "0" (highly ineffective) to "4" (highly effective). Table 3 shows the fleet methods, percentage who use, mean effectiveness rating (to the nearest tenth), and effectiveness rank. The methods are listed in order of their rated effectiveness. When there were ties in the mean effectiveness ratings, rankings were determined by looking at additional decimal places. For simplicity, these are not shown.

The average respondent answered "yes" to 8 of the 19 methods, indicating that these fleet managers and their fleets typically employed multiple methods to promote safety belt use. The most commonly used methods included the following:

- Discuss during safety meetings (87%)
- Policy included in driver handbook (79%)
- Written company policy requiring use (78%)
- Driver use of safety belt included in accident investigation process (75%)
- Observe driver belt use in vehicles (e.g., when drivers are at terminal [73%])

Seven of the methods listed were used by 50% or more of these fleet managers, another indication that the typical fleet manager survey respondent used multiple approaches to encouraging safety belt use among their fleet drivers.

TABLE 3 Fleet methods to promote safety belt use

FLEET METHODS TO PROMOTE SAFETY BELT USE	% Who Use	Mean Effectiveness Rating	Rank (of 18)
Rewards/recognition for observed use	17%	2.9	1
Observe driver belt use in vehicles (e.g., when drivers are at office/terminal)	73%	2.9	2
Punishment/reprimands for non-use	45%	2.9	3
Discuss during safety meetings	87%	2.8	4
Consistent emphasis of belt use for all employees, including supervision	62%	2.7	5
Written company policy requiring use	78%	2.7	6
Testimonials by experienced drivers who avoided injury by using belts	30%	2.7	7
Post signs in vehicles	22%	2.7	8
Driver use of safety belt included as part of accident investigation process	75%	2.6	9
Media training aides (e.g., videos, slides)	44%	2.5	10
Policy included in driver handbook	79%	2.5	11
Post signs in office/terminal and/or driver room	62%	2.4	12
Post statistics on fleet use	8%	2.4	13
Ask candidates during selection interviews or questionnaires	36%	2.4	14
Printed handouts	44%	2.4	15
Change all safety belts to safety orange or other bright color	3%	2.3	16
Coffee mugs, key rings, etc., with safety belt messages	10%	2.3	17
Encourage employees to report drivers for not wearing safety belts	12%	1.9	18
Other method or practice	15%	NA	NA

In terms of effectiveness ratings, most of the methods listed were given moderately high ratings by respondents. The three top-rated methods were rewards/recognition for observed use, observing driver belt use in vehicles, and punishments/reprimands for non-use.

The nineteenth method was "other method or practice" which allowed for anecdotal responses but not quantitative effectiveness ratings. Other methods suggested included the following:

- Paying safety bonuses
- Termination of employment for non-use
- "After an accident, discuss benefit of use with all drivers"
- Review roadside inspection when driver is cited
- Involve the families of drivers

4.2.3 Part 3: Government/Industry Programs to Promote Safety Belt Use

Part 3 presented respondents with eight types of government and industry programs to promote safety belt use. Respondents were asked to rate each program for their effectiveness (using a 5-point scale). The method that received the highest effectiveness rating from respondents was showing crash testing with test dummies with and without safety belts. Table 4 lists possible programs to promote use, in descending order of fleet manager ratings and rankings. Again, the last selection in this section was "other suggested methods" to allow for anecdotal responses. Suggestions included the following:

- Using highway billboards to help promote use
- "Heavier enforcement of ticketing for non-use"
- Start a national "saved by the belt" program
- Mandating safety orange or bright colored belts in vehicles
- Implement "no tolerance" policy
- "Publishing more statistics . . . drivers like proof"

4.2.4 Part 4: Comments

A space was provided for respondent-written comments. Almost one-quarter of the fleet managers made such comments. The comments focused on a variety of issues and expressed a number of different view points. Some of the comments fell

TABLE 4 Government/industry programs to promote safety belt use

PROGRAMS TO PROMOTE SAFETY BELT USE	Mean Effectiveness Rating	Rank (of 7)
Showing crashes with test dummies, with and without safety belts	2.9	1
Testimonials by celebrities on TV, radio, or publications	2.8	2
Providing instructional materials to fleets	2.7	3
TV public service announcements	2.5	4
Radio public service announcements	2.4	5
Magazine/newspaper ads	2.3	6
Government websites promoting safety belt use	1.8	7

TABLE 5 Fleet managers' operation types

OPERATION TYPE	% FLEET MANAGERS
For hire: long haul/truckload	39%
For hire: bulk carrier	8%
For hire: long haul-less-than-truckload (LTL)	8%
For hire: local/short haul (< 100 miles)	10%
Private carrier: long haul or regional/truckload	15%
Private carrier: bulk carrier	2%
Private carrier: long haul or regional LTL	13%
Private carrier: local/short haul (< 100 miles)	3%
Passenger carrier: long haul/motor coach	4%
Passenger carrier: local/transit	1%
Other (mostly variations of the above)	8%

Note: Totals more than 100% because some fleets had more than one operation type.

into the category of the previous survey sections, that is, fleet methods to promote use or government/industry programs to promote use, and were added where appropriate. Some of the other comments included the following:

- "Always set the example . . ."
- "Link it to family safety and ask them to set an example"
- Continuous driver education on the issue
- "Drivers of large vehicles don't think they need belts due to the large size of the vehicle"
- "Keep beating the drum, I wish law enforcement wouldn't ignore it and fines were harsher"
- "Deliver a positive, care taking approach"
- "Teach usage at an early age, increase fines for non-use, and increase points"
- Use photo ticketing

4.2.5 Part 5: Respondents

Respondents were also asked to provide some general demographic information about themselves and their fleets.

The 120 fleet manager respondents had been managers for an average of 11.7 years (range: 1 to 42) and had an average of 22.0 total years of experience in the field of CMV operations (range: 1 to 50). Fleet size varied widely, ranging from four to thousands of power units. The median fleet size was 85 units.

Respondents were asked to characterize their fleet's primary operation by selecting one of ten major truck and bus operation types or writing in an alternative. Results are shown in Table 5. The for-hire long-haul truckload operations type was the most frequent industry segment. The percentages totaled somewhat more than 100% (111%) because some respondents cited two or more operation types.

CHAPTER 5

DRIVER INTERVIEWS

5.1 DRIVER INTERVIEW METHODOLOGY

In order to collect safety belt usage and perception data from truck drivers, the research team designed and used a structured survey interview approach. The survey guide was pre-tested with several drivers to ensure that it could be completed in 3 to 5 min. The structured interviews were conducted at two large truck stops located in the Atlanta and Minneapolis metropolitan areas.

The on-site random interviews were conducted with drivers entering or exiting the truck stop facilities. As added incentive, driver respondents were offered a pre-paid calling card for participating in the survey interview. The survey guide is presented in Appendix C.

Similar to the written survey of fleet managers, many of the driver questions presented in the structured interview tended to be speculative or subjective in nature (e.g., What percentage of the time do you wear a safety belt?). However, several questions were more objective in design (e.g., Is there a penalty at your company for not wearing your safety belt?). Finally, data relating to driver respondent physical qualities such as age, height, and weight were estimated by the interviewer.

Each structured interview with the truck driver was initiated with an introductory discussion that highlighted the research objectives, research team members, and the confidential and voluntary nature of the interview. The objective of the introductory discussion was to ensure that each driver understood that the interview was optional, the data collected could not be traced to them, and that there was therefore no reason to answer in a manner that was untruthful.

5.1.1 Data Collection and Analysis

The structured interviews were given over 3 days at two sites. On the first day, two ATRI interviewers collected data at a truck stop with 90 parking spaces off Interstate-94 in Hudson, Wisconsin (located in the Minneapolis-St. Paul region). On the second and third days, three ATRI interviewers collected data at a much larger 230 parking space truck stop located just off Interstate-285, the Atlanta Perimeter, in Conley, Georgia. Interviewers were on site for 8 hours each day.

The method used to sample truck drivers for this project can best be described as convenience sampling. The investigators, as experts in the trucking industry using common sense, were able to sample a typical or representative segment of the truck driving population. This was partially achieved through the site selection process. In other words, large populations of truck drivers are typically found at well established truck stops. Furthermore, the geographic locations of the sites offered a variety of industry sectors and sizes. Before each interview began, the interviewer confirmed that the subject was a truck driver if he or she had not seen the subject actually driving a truck. Lastly, the first question of the structured interview, "What percentage of the time do you wear a safety belt while driving your truck?" confirmed that the subject was, in fact, a CMV driver.

The sample did not cover, however, all representative driver subpopulations. For example, since data collection occurred between the hours of 8:00 a.m. and 5:00 p.m., regular city interline drivers might be underrepresented. The sample might overrepresent long-haul truck drivers because local delivery drivers were less likely to stop at the major, full-service truck stops such as those located in Hudson, Wisconsin, and Conley, Georgia. Confidentiality was ensured by not recording subject names or the companies for which they worked.

For data collection, interviewers entered responses on-site by hand during each interview. The interview data were later entered into a spreadsheet by an individual who was not an interviewer.

5.1.2 Interview Design and Data

The CMV driver interview guide contains 5 parts:

- **Part 1: General Questions.** These questions asked what percentage of the time a driver wore a safety belt in two separate situations, why the subject made that choice, and what reasons were offered for not wearing a safety belt.
- **Part 2: Functionality.** These questions focused on comfort, usability, complaints, and possible improvements for safety belts.
- **Part 3: Carrier/Driver Interactions.** These questions focused on company policy, penalties, rewards for desired behavior and potential incentives.
- **Part 4: Trucking Related Demographics.** These questions determined driver experience, fleet type, and cargo.

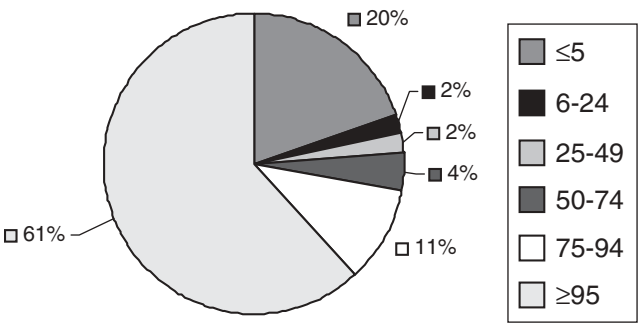

Figure 1. Safety belt use by CMV drivers while driving trucks.

- **Part 5: Driver Demographics.** The interviewer estimated age, height, weight, and gender of the drivers.

5.2 PRINCIPAL INTERVIEW RESULTS

The following represent the findings of the research team's collection of data through 238 interviews of CMV drivers collected at truck stops in Georgia and Wisconsin.

5.2.1 Part 1: General Questions

The first part of the interview guide was designed to make an initial determination of driver safety belt use and the factors that contributed to use or non-use of a safety belt. The first question asked drivers what percentage of the time they wore their safety belts while driving a truck. Because answers could range anywhere from 0% to 100%, they were placed into six categories: 5% or less, 6 to 24%, 25 to 49%, 50 to 74%, 75 to 94% and 95% or greater. Results indicated that 61% of the drivers surveyed stated that they wore their safety belts 95% of the time or more (see Figure 1). Many of those who reported using their safety belts in this category did not use them 100% of the time in order to negotiate sharp turns in urban areas at low speeds, pull into the company lot, or drive their truck in reverse. Placed together with the 11% who reported wearing their belts between 75% and 94% of the time, approximately 72% of drivers stated that they wore their safety belt all or most of the time. A reverse bell curve is found in these results (see Figure 2), with very few drivers falling in the range of 6% to 74%. There is a spike in the strong non-user category—those who wear safety belts 5% of the time or less—accounting for one-fifth of the interviewed population.

Drivers had similar behavior regarding use of a safety belt while driving their personal cars. Though individual drivers did not correlate exactly, overall, there was a strong comparative pattern for the interviewed population (see Figure 2).

A third question asked drivers to consider why they did or did not choose to wear a safety belt. Among all drivers who responded to this question, the greatest factor in making the choice to wear a safety belt was 'safety,' representing 39% (see Table 6). Other reasons for using a safety belt included the coercive factor found in law enforcement (19%), having seen or been in a "shocking" accident (11%), and having received a fine (9%). Approximately 12% suggested that they made the choice to wear a safety belt simply out of habit.

Respondents who listed reasons they chose to not wear a safety belt offered the discomfort of the device (38%) and personal choice and general dislike of safety belts (34%) as their top motivations. Nearly 14% felt that wearing a safety belt was actually more dangerous than not wearing one for reasons such as being trapped in a fire or during a rollover. Another 8% claimed that their mobility was limited by safety belts, especially while negotiating turns in urban areas.

In question four, respondents were given a choice of five likely reasons not to wear a safety belt and were allowed to offer their own answers as well. They were able to choose as many answers as they thought were valid (see Table 7). Of the 175 respondents who felt valid reasons existed, 64% stated that the discomfort of safety belts was a valid reason. Nearly one-half of the respondents thought that it was legitimate not to wear a safety belt because it represented an infringement of rights and because drivers could become trapped in the vehicle after a crash. More than one-quarter believed that forgetting to put on the safety belt was a valid reason, and 14% indicated that the trouble and effort it took to use a safety belt was a valid reason not to wear one. In the interview guide, there was an option to choose other reasons that the respondent

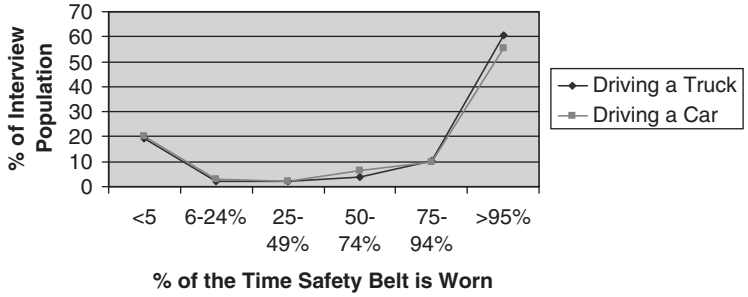

Figure 2. Safety belt use by CMV drivers while driving a truck and while driving a car.

TABLE 6 Reasons drivers wear or do not wear safety belts

WHY DO YOU CHOOSE TO WEAR A SAFETY BELT?	NUMBER	PERCENTAGE
Safety	74	39%
Because it is the law	36	19%
Out of habit	22	12%
Seen or been in an accident	21	11%
Have received a fine or ticket	16	9%
Company policy	6	3%
Because of children	6	3%
When driving through weigh scales	5	3%
Because of other drivers	2	1%
Total	188	
WHY DO YOU CHOOSE NOT TO WEAR A SAFETY BELT?	**NUMBER**	**PERCENTAGE**
Uncomfortable	19	38%
Personal choice or general dislike	17	34%
Because safety belts are dangerous	7	14%
Need mobility while maneuvering	4	8%
Truck is not equipped with a safety belt	2	4%
Do not know	1	2%
Total	50	

believed might be valid for not wearing a safety belt; few chose to take advantage of this option, and none chose the same answer. These responses included if a driver was fatigued, if the driver did not feel he or she needed a belt, if the belt was too small for the driver, or if the driver feared decapitation.

5.2.2 Part 2: Functionality

Part 2 began with a general question on usability. It stated: *If truck safety belts were more functional, comfortable, and easy to use, would you be more inclined to wear them?* Of the 238 respondents, only 76, or 32%, said yes to this question. This could be attributed to the strong non-users, and those who always wore a safety belt: they generally did not feel that there was anything that would change their minds, or, in the case of the latter group, they already wore their safety belts all of the time.

For those 76 respondents who replied yes to the question of usability, an additional option was given for four underlying issues that make their safety belts difficult to use or uncomfortable. These issues were (1) limited range of arm and shoulder motion, (2) the lap belt or shoulder harness was not long enough/too tight, (3) shoulder harness position was awkward, and (4) the belts rode too high or too low.

Respondents were able to choose as many as they wished. Of the 76 drivers who said yes to this question, 36% indicated that the awkwardness of the shoulder harness position made the safety belt either uncomfortable or difficult to use (see the ergonomics assessment of this problem in Chapter 7 of this synthesis), and 33% stated that the length of the shoulder harness, or its tightness, was problematic. More than 22% of drivers indicated that the limited range of motion caused discomfort and difficulties, and finally, one-fifth mentioned the belt's position—either too high or too low—as a cause for their problems.

The second question of this section asked what the biggest complaint about safety belts was for the driver. Approximately 62% of drivers interviewed provided a response to this open-ended question; there were a variety of 'most significant' complaints listed, and results were placed into 19 separate categories (see Table 8). Of those providing an answer to this question, 28% stated that they had no complaints regarding safety belts. It should be noted that most of those who did not respond—38% of the total group interviewed—generally did not have complaints about safety belts, and thus did not provide an answer. Consequently, of the 148 who did indicate an answer to this question, 106 listed actual complaints as seen in Table 8. The majority of complaints referred to comfort issues regarding safety belts, while there was a small faction whose primary complaint was law enforcement's role in safety belt use and infringement on personal rights (approximately 9%). The most widespread complaints of the 106 were that the safety belts rubbed or vibrated against the neck or shoulders (27%), safety belts locked frequently when the

TABLE 7 Valid reasons for not wearing a safety belt

VALID REASONS FOR NOT WEARING A SAFETY BELT	NUMBER	PERCENTAGE
It is uncomfortable	112	64%
It is an infringement of rights	86	49%
Driver could become trapped if there is an accident	82	47%
Driver forgets to put it on	50	29%
It is too much trouble and effort	24	14%

TABLE 8 Chief complaints about safety belts

TOTAL RESPONSES	NO.	%
Driver indicates no complaints	42	28%
INDICATES A COMPLAINT	**NO.**	**%**
Safety belt rubs or vibrates against neck/shoulder	29	27%
Safety belt locks	16	15%
Safety belt is uncomfortable	15	14%
Safety belt is too tight	10	9%
Safety belt has limited range of motion	8	8%
Mandatory safety belt use is an infringement of rights	6	6%
Safety belts are not safe	5	5%
Material is too hard	3	3%
Safety belts are mandatory	3	3%
Lap belt is uncomfortable	2	2%
Dislike safety belts in general	2	2%
Forget to wear	2	2%
Belt loosens up	1	1%
Shoulder strap gets twisted	1	1%
Driver is required to take it off and on frequently	1	1%
Needs an emergency release	1	1%
Blocks mirror	1	1%
Buckle gets stuck	1	1%

driver moved around the cab (15%), and safety belts were generally uncomfortable (14%).

The third question of this section asked the drivers what, in their experience, made a safety belt easy to use (see Table 9). Respondents were given a choice of four answers and also had the option to provide an answer that might not have been included. The drivers could select as many as they liked. Of all drivers interviewed, nearly one-half (46%) stated that a safety belt that was easy to take off and put on made that system easy to use. Drivers also indicated that safety belts were easy to use (1) if they did not interfere with driving (39%), (2) when they were easy to position (36%), and (3) when they were not too tight (31%). Drivers also mentioned that comfortable and automatic safety belts allowed for greater ease of use.

The final question of this section asked respondents what changes could make a safety belt less difficult to use. This was an open-ended question, and answers were placed into the 14 categories listed in Table 10. Of the 170 responses recorded, 68 drivers (40%) indicated that there was nothing that could make a safety belt less difficult to use; however, 102 drivers did indicate that a change would make safety belts easier to use, including 22 (13%) who believed that if safety belts were adjustable they would be less difficult.

TABLE 9 Attributes that make a safety belt easy to use

REASON	NO.	% of Total
It does not fit too tight	74	31%
It does not interfere with my driving	94	39%
It is easy to put on/take off	110	46%
It is easy to position	85	36%
It is an automatic belt	2	1%
It is comfortable	2	1%

TABLE 10 Changes that could potentially make a safety belt easier to use

TOTAL RESPONSES	NO.	%
Drivers indicated nothing could make safety belts easier to use	68	40%
INDICATES A CHANGE	**NO.**	**%**
If the belt were adjustable	22	13%
Softer material/more cushion	17	10%
Racing harness/4-point system	17	10%
Automatic	12	7%
If it were a lap belt only	9	5%
Buckle easier to use	5	3%
No locking	3	2%
Looser	2	1%
Emergency release	2	1%
Vehicle does not start w/out belt on	1	1%
Reminder voice	1	1%
Fit bigger drivers	1	1%
Other	10	6%

Softer or cushioned safety belt material and a 4-point harness system, such as those used by race car drivers, were each indicated as a potential solution by 17 drivers (10% of the total responses for each category).

5.2.3 Part 3: Carrier/Driver Interactions

The third section of this interview focused on interactions between drivers and the carriers who employed them (if they worked for a carrier, i.e., if they were not independent owner/operators). The first question asked drivers if there were company policies requiring safety belt use: 51% of drivers indicated that there was a policy, while 37% indicated there was none, and 11% were uncertain if there was a safety belt policy or not.

Those who indicated that there was a safety belt use policy at their company were subsequently asked whether violations of the policy lead to negative consequences. Of the 123 drivers that answered yes, 144 responses were collected. Those who indicated tiered penalties generally stated that there was a reprimand, a suspension, and finally termination, thus accounting for more responses than respondents (see Table 11).

TABLE 11 Company/other penalties for not wearing a safety belt

PENALTIES	No.	%
No penalty	54	44%
Written up/ reprimand	31	25%
Uncertain	28	23%
Termination	10	8%
Suspension	5	4%
Yes, but no specifics	6	5%
Left up to the law/tickets	6	5%
Company fine	1	1%
Loss of radio	1	1%
Other	2	2%

TABLE 12 Rewards or education offered by employers

TYPE OF REWARD OR EDUCATION	No.	% of all responses	% of 54 drivers w/ edu./rewards
None	103	43%	--
Safety belt covered in training	30	13%	56%
Safety belt covered in regular safety meetings	10	4%	18%
Uncertain/no answer	81	34%	--
Safety bonus/rewards	7	3%	13%
Yes, no specifics	4	2%	7%
Educational video	2	1%	4%
Shock video	1	0%	2%

Of the 144 responses to this question, 54 drivers (44%) indicated that there were no penalties for violating company safety belt use policy, 31 drivers (slightly more than 25%) stated that a penalty was given in the form of a verbal or written reprimand, and approximately 28 drivers (23%) were uncertain what the penalty was for violating their safety belt use policy, indicating that penalties were probably not given out at those companies. Only 10 drivers (8%) listed termination as part of their company's safety belt use policy.

The second question of this section asked drivers if their company offered driver rewards or positive recognition for wearing their safety belts, or if they offered any educational courses on safety belt use. This was an open-ended question with answers being placed into eight general categories (see Table 12).

Of 238 drivers surveyed, only 54 drivers (23%) indicated that rewards or education were offered by their companies. Of those who indicated that they had received education or were eligible for rewards, 30 drivers (56%) stated that safety belt use had been covered in training and just under 19% stated that safety belt use was covered in regular safety meetings. Nearly 13% responded that safety bonuses or rewards were given by their companies.

The final question of this section asked drivers what type of incentives would motivate them to wear their safety belts. The answers to this open-ended question were organized into 11 categories (see Table 13). Of the 163 who responded to this question, 45% stated that no incentives could change their safety belt usage. These drivers were probably either strong non-users or wore safety belts all the time. This could also be said for the drivers who chose not to answer the question. Another 12% indicated an uncertainty about whether incentives would work, because enforcing compliance was nearly impossible while drivers were on the road. The remainder suggested incentives such as money and monetary bonuses (14%), gift cards or other small rewards (4%), and awards (1%). Also listed as incentives were educational opportunities, personal reasons, safety benefits, and increased enforcement of laws and policies.

5.2.4 Part 4: Trucking-Related Demographics

In this final section of interview questions, drivers were briefly asked about demographics relating to their driving history and their companies. Drivers were first asked how many years they had been driving (see Figure 3). Generally, there was a downward trend from drivers who had 0 to 5 years of experience to those who had decades of experience. Some interviewers were told that an influx of new drivers in what the drivers saw as a struggling economy outside of the trucking industry was responsible for this trend.

Respondents were then asked whether they were long-haul or short-haul drivers. Not surprisingly, more than 86% were long-haul drivers. This finding supports an argument that long-haul truck drivers have a higher than average safety belt use rate. Alternatively, LTL and courier drivers indicated during focus groups that short hauls and regular deliveries

TABLE 13 Potential incentives to increase safety belt use

INCENTIVES	No.	%
There are no incentives	73	45%
Money/ monetary bonuses	23	14%
Uncertain	19	12%
More education on consequences/shock	18	11%
Gift cards/ phone cards/small rewards	6	4%
General safety benefits are incentive enough	5	3%
Personal reasons, such as having children	3	2%
More enforcement/higher fines	3	2%
Awards	1	1%
Avoiding enforcement	1	1%
Other/off topic	11	7%

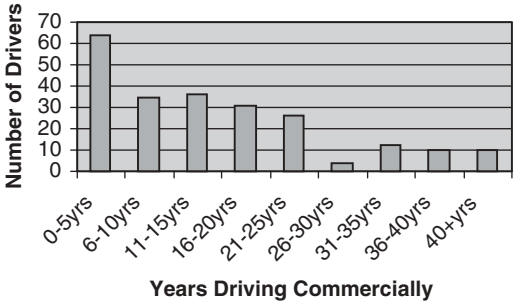

Figure 3. CMV drivers' years of driving experience.

required them to take their safety belts off more often. The likely conclusion is that length of haul and sector of industry may have a high correlation to safety belt usage.

Additional responses in this section showed that 68% of respondents worked in a for-hire capacity or for a for-hire trucking company. Of these, 79% indicated that they were truckload carriers, while 17% were LTL carriers. LTL carriers were more likely to have frequent stops and be short-haul carriers.

5.2.5 Part 5: Driver Demographics

Finally, the interviewers estimated four demographic classifications for each driver interviewed immediately following each interview. Of the 238 drivers interviewed, only 8 were women. Figures 4, 5, and 6 indicate the estimated age, weight, and height, respectively, of the drivers interviewed. The data for the 20% who were non-users (wore safety belts less than 5% of the time) were isolated, and their demographics were similar to those demographics indicated in these figures.

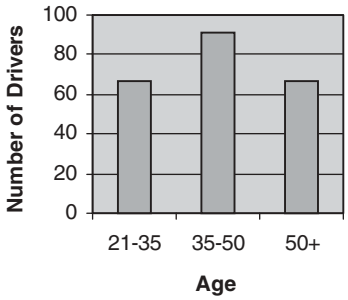

Figure 4. Estimated age of drivers interviewed.

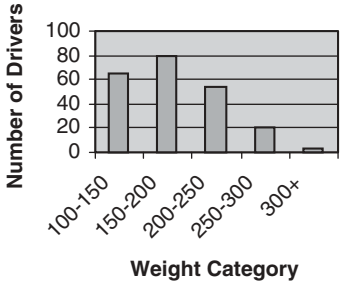

Figure 5. Estimated weight of drivers interviewed.

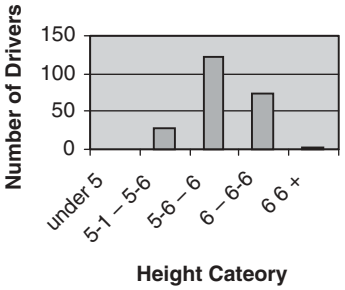

Figure 6. Estimated height of drivers interviewed.

CHAPTER 6

COMMERCIAL DRIVER FOCUS GROUPS

6.1 INTERVIEW METHODOLOGY

Research team members held two focus groups with CMV drivers in Utah. The first was held at the American Trucking Association's National Truck Driving Championships (NTDC), and driver competitors formed the focus group. Seven NTDC drivers offered insight into their use of safety belts, as well as perspectives on general driver population safety belt use. The second focus group took place at a private trucking company terminal (Company A) in Garfield, Utah. Four drivers, two mechanics, and one terminal manager made up the second focus group. The terminal was a HazMat tanker operation with a combination of long-haul and local deliveries.

Research team members used the same structured interview guide from the CMV driver truck stop visits (see Appendix D); questions on trucking-related and driver demographics were omitted. Each question was posed to the entire group, and answers were given by any participant who wanted to add to the conversation. Notes were taken at the focus groups. The focus groups were conducted in three parts:

- **Part 1: General Questions.** This section's questions generally focused on the percentage of time the driver wore a safety belt when driving a truck, the basis for that choice, and what reasons were considered valid for not wearing a safety belt.
- **Part 2: Functionality.** This section concentrated on safety belt comfort, usability, complaints, and the potential for improvements.
- **Part 3: Carrier/Driver Interactions.** In this final section, the focus group leaders and participants discussed company policy, penalties, rewards for desired behavior, and potential incentives.

6.2 PRINCIPAL INTERVIEW RESULTS

6.2.1 Part 1: General Questions

Initial discussion of safety belt use focused first on general questions about use and reasons for particular usage behavior. During the NTDC focus group, drivers responded that they wore safety belts when driving a truck from 20% of the time to 99% of the time. Those who claimed "nearly always" stated that the 1% non-use occurred in places such as truck stops, when they were prone to removing their safety belts before they parked. One driver stated that he wore his safety belt 60 to 70% of the time, with frequency of use depending on what route he was driving on any given day. As an LTL driver, he might have to stop as frequently as every block, which reduced the chance of him wearing a safety belt. This was due to a desire not to make the effort of putting on a safety belt when it would have to be removed shortly and also due to forgetting to use the safety belt.

When participants were further probed as to why they chose to wear safety belts, a staunch user of safety belts stated that he wanted to avoid tickets from law enforcement. A driver who wore his belt only 20% of the time reported that when he did wear his belt, it was when he noticed that those who were driving cars near him were operating their vehicles in an unsafe manner. Finally, an LTL driver who wore his belt 60 to 70% of the time again reinforced the idea that when delivering door-to-door, it was not convenient or habitual to constantly use a safety belt. He admitted that he continued this behavior even though company policy forbade it, and he had received a great deal of training on the subject.

Of the valid or purposeful reasons not to wear a safety belt, discomfort was a top choice. One participant stated that the safety belt system locked on drivers and that was a good reason not to wear one. The group was then pressed further to discuss safety belts that locked. It was revealed by one participant that many drivers did not know how to use the lock strap properly and that most drivers did not know how to use the system that allowed for shoulder straps to be adjusted for greater comfort (participants stated this system was widely available).

While participants did not propose "forgetting to put on the safety belt" as a valid reason for not wearing it, they again admitted that forgetfulness could become habitual when making numerous deliveries in a short period of time. The group generally condemned the infringement of rights argument, stating it was flawed because, in part, drivers were using someone else's vehicle. Finally, regarding being trapped by a safety belt in a vehicle crash, participants claimed that this was a concern and a possibility, but not a valid reason for not wearing a safety belt. One participant had never heard of a case where a driver had been trapped in a vehicle by a safety belt.

For the Company A group, the response was that they wore the belt 100% of the time working for Company A, but did not necessarily use the belt 100% of the time before moving to the company. (Some of these drivers had previous experience with other companies before working for Company A. Company A has a very strong policy.) Now that it was a habit and these drivers knew more about the hazards of not wearing a safety belt (through training), they would still wear it if there were no longer a policy. One participant stated having children/grandchildren helped: "They ask 'why' if you are not wearing it (your safety belt)." Consensus was that older drivers wore safety belts because as they got older, they had a greater appreciation for life. Several participants witnessed cases where lives could have been saved if drivers were wearing safety belts.

When answering the same question related to non-commercial vehicles, the consensus was most, but not all of the time. Reasons included old habits and car safety belts not being as comfortable as truck safety belts.

Company A employee answers to "why you choose or don't choose to wear a safety belt" included the following:

- Company policy
- Termination of employment for non-compliance
- Protection from bad drivers
- Possibility of being maimed and permanently disabled more of an incentive than death

The only reason for not wearing a safety belt seemed to be forgetting. The Company A drivers indicated that they did not feel that wearing safety belts infringed on their personal freedom but that they had heard that from other drivers. They also recognized the "being trapped" argument as an old myth.

6.2.2 Part 2: Functionality

When initially asked about the discomfort of safety belts being a deterrent for use, there was an initial consensus among the NTDC focus group that comfort was not a major issue, although the locking belt problem had surfaced earlier. One participant stated that safety belts could be adjusted for comfort, while another claimed that changing the belt to be any more comfortable than it already was might compromise safety.

However, some specific instances of discomfort were discovered through further discussion. They again maintained that discomfort was present when the safety belt locked up, especially while backing up the truck or when the brakes were applied. It was also said that cars did not have the same belt locking problems that trucks had.

Furthermore, the harness strap was found to cause discomfort when drivers reached upward or downward to give money at toll booths. Toll booths seemed to be a place where a safety belt might be taken off to decrease pain when paying the toll and might stay off well after the toll had been cleared. While some drivers maintained that they had no complaints about safety belts overall, when asked what their biggest complaint was, participants often listed several items. One driver made it clear that while he liked the safety belt tight on his body, he did not like it when it rubbed his skin. When the topic of pads to alleviate the rubbing was mentioned, drivers stated that the pads had problems, including that they did not stay in place. It was also suggested that padding was costly, and that companies should provide padding to their drivers on an annual basis.

Drivers agreed almost unanimously that nothing could make the current standard safety belt, the three-point system with lap and shoulder belts, any easier to use. But when the idea of a reminder buzzer was proposed, the group was split. Some felt that the buzzer would help them remember to wear a safety belt, as it was intended to do; but, others felt that the buzzer would be bothersome and/or anger them and that there would be a way for a driver to override the buzzer system. One participant claimed that if a short-route driver had a buzzer, deliveries would take forever, indicating that if short-route drivers had to wear a safety belt, deliveries would be less efficient or timely. Safety belt use among short-route drivers was thus implied to be infrequent during deliveries.

The Company A drivers/employees expressed similar opinions. For the most part, they found truck safety belts more comfortable than those in their private vehicles. They liked the "big handle clip" for adjusting tension but did not care for the "small wedge." ("It doesn't always hold and you end up having to readjust.") Neck-chafing was also their biggest complaint. They all agreed that buzzers and lights would be a good addition, making truck systems similar to cars.

6.2.3 Part 3: Carrier/Driver Interactions

All NTDC focus group drivers stated that their companies had safety belt use policies in place. This difference from the results of the driver interviews can possibly be attributed to the types of drivers and companies that participate in the American Trucking Associations' NTDC. They are deemed to be the best in the industry in safety. The consequences for violating company policy varied and included warnings, write-ups, and suspensions. It was indicated that much of the policy enforcement engaged in by companies occurred on company land. It was concluded that some drivers therefore removed their safety belt once they were out of sight of company enforcement.

There were few responses regarding rewards from companies for safety belt use. One participant mentioned that if they were viewed wearing their safety belts, their names would appear in a special section of the company newsletter. Another mentioned that there was a jacket giveaway at one point in his career. A final participant mentioned that law enforcement personnel had been known to pull over truck drivers who were wearing their safety belts and congratulate

them. Several drivers felt this recognition should be more widespread.

There were several answers to the question of incentives to use safety belts among CMV drivers, but most efforts or potential efforts discussed were, in fact, instances of negative reinforcement. One participant remarked that maintaining a clean record, and thus retaining reasonable insurance rates, was incentive enough. This would indicate a push toward greater government enforcement of safety belt laws or a push toward greater use of primary laws (those where a driver could be pulled over just because he or she was not wearing his safety belt). It also indicated that insurance companies should increase the penalties for those who did not wear their safety belts and were penalized for it. There was also an indication that higher fines would encourage behavior modification.

Regarding educational incentives, showing the results of crashes where a driver was not wearing his safety belt, either through shocking videos, general reenactments, or statistics, were all mentioned as ways to change behavior; these, however, are not true incentives to changing behavior. They equate to an education of the negative results of undesired behavior.

Company A also has a strong policy; a driver can be fired for a first offense if observed on the road not wearing a safety belt. Wearing a safety belt was a condition of employment. Company A provided numerous educational courses and statistics about previous driver fatalities where safety belts would have made a difference. These drivers agreed that training helped them break their old habits of not wearing or forgetting to wear a safety belt. Driver recognition included a ring that required 3 consecutive years without any accidents/injuries/safety violations to earn. Not wearing a safety belt was one of those violations. Two diamonds were added for each additional 3 years. A full ring contained 8 diamonds.

CHAPTER 7

ERGONOMIC AND TECHNOLOGICAL FACTORS AFFECTING SAFETY BELT USE

7.1 BACKGROUND

This chapter focuses on ergonomic and technological factors that might affect driver choices to use safety belts. This section provides general background and perspective on the safety belts and how they are chosen for installation in commercial vehicles. The following sections describe an ergonomics assessment of current safety belt use, technological and human factors related to safety belt technology, evolving technologies in safety belts and user-friendly design, and conclusions for consideration by the Partnership.

The fundamental safety belt system in use in CMVs today is a 3-point system that came about in the 1980s. In addition to employing the usually expected driver-restraining lap belt, the 3-point safety belt system incorporates a shoulder strap which is fastened to the truck cab's "B-pillar" support structure above and slightly behind the driver's left shoulder (see Figure 7). Through the 1990s, in an evolutionary way, the 3-point safety belts underwent several design improvements. Since the mid-1990s, 3-point safety belts have been adopted industrywide and are now considered standard equipment.

Based on representation from six OEMs of commercial trucks, it appears that 90% of the largest and principal fleet trucks sold in the United States today are being equipped and installed with safety belts manufactured by one safety belt company. The precise market share of this manufacturer was not independently verified for this study, but it is clear that focus on this firm's product is valid for considering ergonomic factors in the design of truck safety belts in the United States.

Product engineers and sales representatives of this company provided a technical presentation and demonstration of the design features and operation of their safety belts to the Partnership meeting held at FMCSA in April 2004. Technical and sales representatives also met with the research team ergonomist for an interview session at the Freightliner Trucks facility in Portland, Oregon, in October 2004.

There are other safety belt products available, but they are found less frequently in the U.S. long-haul trucking industry. Based on interviews with OEM representatives, the largest Class 8 truck manufacturers tend not to procure and install these other safety belts in trucks they sell, unless other brand name safety belts are specifically requested to meet a customer's special order.

An ergonomic evaluation of safety belts must include significant consideration of the choice of seats installed in the truck. Truck safety belts are mounted in conjunction with the particulars of each seat selected, because safety belt design must interact with the particular seat a driver is using. Seat design features of functionality, adjustability for best reach of pedals and controls, visibility inside and outside the cab, absorption or attenuation of whole body vibration (WBV), overall ease of use of the seat, seat comfort, compatibility with the safety belt design, and ease of seat care and maintenance, all are involved in the ergonomics and human factors considerations of selection, installation, and use of truck seats and safety belts.

Because the ergonomics assessment in this study is primarily oriented to safety belts, the specifics of the many varieties of Class 8 truck seats and the numerous human factors and ergonomics considerations of seats per se are only mentioned here insofar as they have a direct impact on safety belt design factors.

7.2 ERGONOMICS ASSESSMENT METHODOLOGY

This section presents ergonomics and human factors engineering information as part of an assessment of the design and use of the safety belt systems more commonly employed in contemporary Class 8 trucks on the highways of the United States. Professional ergonomics standards, measurements, and seat evaluation guidelines (e.g., those established by C. M. Gross et al. at the Biomechanics Corporation of America, Melville, NY) (Gross 1996) were applied in the assessment. The methods followed were (1) to conduct a literature search of reports containing information on CMV safety belt design—in particular, to identify any human factors or ergonomics studies of the safety belts; (2) to examine and conduct an ergonomics inspection of a variety of Class 8 truck safety belts, safety-belt-to-truck-seat combinations, or interactions among the seats and safety belts—to perform an examination of the installation of safety belts in different varieties of Class 8 trucks; (3) to interview and witness in operation a variety of

Figure 7. Three-point safety belt in a Class 8 truck.

CMV drivers who differed anthropometrically (body sizes, etc.) while the drivers wore or used truck safety belts; and (4) to highlight some newer design technologies for possible subsequent application to safety belt installations in Class 8 trucks.

To study the different approaches employed in fielding Class 8 trucks, the research team ergonomist examined the interaction(s) of the 3-point safety belt with several alternative air-ride truck seat designs, with different-sized drivers, and in different kinds of truck cabs. The examination sampled about a dozen different truck driver seats-to-safety-belt combinations (i.e., different brands and models of trucks and different brands and models of truck seats). The ergonomics assessment was not an exhaustive one in that it did not include a comprehensive assessment of the numerous truck brands and models and seat brands and models available in the U.S. long-haul trucking fleets.

The research team visited several OEMs to examine the installation of current seat and safety belt designs and to study differing approaches employed in fielding new Class 8 trucks around the United States. The staff engineer at the Truck Manufacturers Association (TMA) and a participant in the Partnership (1) coordinated with several key OEMs to arrange visits to their facilities to examine the installation of safety belts in different brands and models of new trucks and (2) facilitated discussion with OEM representatives on these topics. OEMs contacted included Freightliner, Mack, International Truck and Engine Corporation, and PACCAR (Peterbilt and Kenworth).

During a visit to one of the OEMs, the research team ergonomist examined in-depth one particular new truck with some of the latest optional safety belt features installed. An on-the-road test ride and demonstration of the truck driver and passenger seats, and the safety belts accompanying them, was conducted as part of the ergonomics assessment. The truck included a modern air-ride seat. The seating arrangement in that truck included a 3-point safety belt (see Figure 8), complete with two optional features designed to enhance driver comfort in using safety belts: (1) a shoulder strap D-loop height adjuster (see Figure 9) mounted on the truck cab's B-pillar that permitted the driver to select about 7 in. of stroke adjustment for shoulder strap placement to his/her preference and (2) a shoulder strap equipped with a safety belt latch in place that permitted drivers to insert an extra inch or two of slack in the shoulder belt for added comfort as the strap crossed the driver's chest (see Figures 10 and 11).

The 45-min on-the road demonstration ride included traveling at varying speeds, enacting random forced quick stops, driving around banking turns, roadway inclines and declines, and driving over substantially bumpy roads, railroad tracks, and so forth. In a truck static mode, ergonomic observations and measurements were made with three drivers: a medium-sized man, a large, tall man, a smaller-statured woman seated in the driver's seat.

In addition to visiting several OEMs, the research team also visited several truck carrier terminals and several public and commercially run truck rest stops in the states of Florida, Maryland, Oregon, South Carolina, and Virginia. At these locations, drivers were interviewed about their safety belt use. The research team's structured interviews of CMV drivers and of fleet managers (see Chapters 3, 4 and 5) included questions about safety belt ergonomics and comfort issues that could affect safety belt use.

Figure 8. Safety belt viewed from lap connector.

Figure 9. Shoulder strap D-loop height adjuster.

Figure 11. Shoulder strap tension adjustment mechanism (latched).

7.3 RESULTS OF ERGONOMICS ASSESSMENT

In general, the professional opinion of the research team ergonomist is that safety belts being installed in Class 8 trucks appear to be practical and functional. The belts effectively serve a large portion of CMV drivers (approximately the 20th to the 80th percentile anthropometrically). However, it is the research team's view that the design of universally used safety belts does not serve well the population of large, heavy-set, obviously obese drivers. Additionally, the shoulder belt may rub or chafe the necks of small-statured drivers. These two design problems with the CMV safety belts are addressed in more detail in this chapter.

Figure 10. Shoulder strap tension adjustment mechanism (unlatched).

It seems clear that over the past decade, industrial design and ergonomics work has been focused on making the overall design of safety belts user friendly, incorporating flexibility in facile ease-of-use design attributes, driver comfort features, and appropriate user-fit considerations.

New safety belt designs include two features to make the placement of the lap belt and shoulder strap more flexible by (1) allowing for shoulder strap height adjustments on the B-pillar to accommodate larger or smaller drivers through installation of a shoulder strap D-loop height adjuster and (2) permitting the driver to adjust the amount of belt and strap tension and pressure, particularly of the shoulder strap against the driver's chest and upper torso through use of a shoulder strap tension adjuster. However, most of the trucks examined during this ergonomics assessment either did not have these new features installed, or in many of the cases where they were installed, the drivers did not appear to use

them. In some cases, it was obvious the drivers did not know how to use them until shown by the ergonomist.

7.3.1 Instruction on Care and Maintenance of Safety Belts

The safety belt installation and user manual that the research team observed provided ample instruction and guidance on how drivers should use, care for, inspect (every 20,000 miles), and maintain their safety belts. Some OEMs incorporate portions of these instructions directly into the actual new truck owner's driver manual issued when a new truck is purchased. Upon delivery of every new truck, a few OEMs also provide a VHS video tape illustrating operation and maintenance of the new truck; and these tapes also include proper safety belt instruction.

7.3.2 Driver Complaints with Safety Belt Features

Several past surveys (e.g., Balci, Vertz, and Shen 2001) reported truck drivers complained that their safety belts got trapped in the cab door, twisted, cinched, or locked up; they found the buckle difficult to operate, requiring two hands to fasten or open; or safety belts were difficult to locate to put on or take off. Drivers claimed safety belts were difficult to manipulate or to wear, especially with heavy winter clothing on; or they complained the belt pulling was not smooth; or the belt became loose and slack over time; or the shoulder belt slipped off the shoulder. The research team found similar issues in the literature review and in field interviews. In discussions with the research team, drivers complained that the belts (lap and shoulder) rubbed or chafed their skin, waist, shoulder, and neck.

The research team ergonomist witnessed some of these complaints. However, the research team's ergonomics assessment found no obvious safety belt design features that contributed to or made many (but not all) of these complaints a reality on a regular basis (day to day usage). The research team did observe that some drivers did not know how to use safety belts properly or how to take care of and maintain their safety belts. Both situations were encountered in this evaluation.

7.3.3 Need for Training in Proper Use of the Truck Safety Belts

Truck drivers gave numerous reasons for choosing not to wear their safety belts. Many of those reasons were highlighted in the results of fleet manager and driver surveys in this synthesis. During the ergonomics assessment, the research team ergonomist, while interviewing CMV drivers seated in their trucks, encountered several instances where the drivers seemingly had little actual experience using or wearing their safety belts. In some cases, safety belts (even in rather used trucks) were hung neatly along the B-pillar, but the belt material exhibited few "wear and tear" markings normally indicative of repeated use. The observation of a lack of understanding about how to use safety belts was found to be true in general throughout the interviews of approximately two dozen drivers.

Thus, in addition to convincing drivers to regularly use their safety belts, it is apparent that more training on the proper use of the safety belts as they were designed to be used may be an important issue as well.

7.3.4 Physical Characteristics of Truck Drivers Using Safety Belts

Some driver complaints regarding safety belt features are attributable to the huge variety of physical characteristics of the driver population (e.g., trying to accommodate a wide variety of anthropometric and biomechanical considerations of the driver population itself, that is, big drivers and small drivers). The ergonomics assessment notes that very large drivers, particularly very tall and heavy-set drivers, and those with very large waistline and chest measurements, are likely to have difficulties in comfortably using any 3-point lap and shoulder belt design. Additionally, small-statured drivers, particularly less than 30th percentile drivers, will have difficulties with the 3-point belt systems.

For very heavy-set, "large-bellied" drivers, it is very difficult to properly position the lap belt as recommended by safety belt designers: "2 to 4 inches below the waist, low on the lap, against the thighs, and tight against the hips—but never wearing it over the abdomen or stomach." Such placement of the lap belt below the large stomach would cause the belt material to "cut" into the skin, the waist, and the abdomen; and undoubtedly it would be quite uncomfortable. Properly worn shoulder straps are supposed to cross the collarbone and fit snugly between the breasts. The research team ergonomist witnessed evidence that some larger drivers and some smaller drivers had troubles with proper, comfortable placement of the shoulder belt as well.

The small-statured driver must contend with additional anthropometric compatibility issues. It is challenging for a small driver to properly adjust most of the air-ride seats so that he/she can comfortably reach the controls (especially pedals, gear shift lever, radios, instrument panel knobs) in the cabs of some Class 8 trucks. Therefore, selection of a seat for the small-statured driver is an important consideration.

During an interview with an OEM design engineer, a small-statured woman (5 ft. 2 in. tall and 120 lbs) who also was a CDL holder, questions were raised about various ergonomic factors of seat and safety belt design as they affected small drivers. Before driving on the road, the small driver set the adjustable controls of the driver's air-ride seat for needed positioning fore-aft and for height, and set the safety belt and shoulder strap for preference. Then as the woman explained, while driving over rough, bumpy roads, railroad tracks, and so forth, a certain amount of jostle and bounce would be experienced. This could have a disconcert-

ing effect on the small driver's ability to control the vehicle or, at the very least, on the small driver's ability to maintain continuous visual contact with the road in front of the vehicle. The seat lap belt might lock up or cinch tight; and the shoulder strap was likely to slide or rub against the driver's neck and upper chest area in ways that most small drivers found uncomfortable. On the test ride in the truck, the research team ergonomist estimated that while riding over bumpy roads and over railroad tracks, the air-ride seat vertical stroke easily rose and fell through a range of anywhere from 3 to 6 in. in height. Although the description of the "bounce" of the air-ride seat pertains to larger drivers as well, the problem seemed more acute to smaller-statured drivers.

7.3.5 Seat, Safety Belt, and B-Pillar Placement in the Truck Cab

An ergonomic evaluation of safety belts must include significant consideration of the choice of seats installed in the truck. There are several different seat vendors that supply air-ride and other seats installed in trucks, and there is no standard combination included in all trucks supplied by the various OEMs.

While installing various truck seats and safety belt combinations, there will be slight differences in functionality and the comfort aspects of the seats and of the safety belts (lap belts and shoulder harness strap). In part, these differ in each truck cab configuration as a function of where specifically the seat mountings are positioned in the cab, and with the structural design of the cab, in particular with reference to the B-pillar behind the driver. As these characteristics relate to a driver's comfort in the use of the safety belts they can be attributed to these key variables, both of which affect the functionality of the safety belt and its relative comfort characteristics:

- Precise positioning of the shoulder loop web-guide relative to the seat back and
- Additional features the OEM placed on the seat safety belt (e.g., shoulder strap height adjuster and shoulder strap tension adjuster), whether these were sold as standard inclusions on particular truck models or installed as additional options at the special order request of the client (fleet or independent owner operator) purchasing the vehicle.

When the B-pillar is farther back from the driver's seat, the "angle of attack" of the shoulder strap to the seat must be modified through use of a strap height adjustment, or else the shoulder strap will cause discomfort to the driver during upper torso body movements to operate the truck. Additionally, the lap belt end brackets and the seat lower tether mounting brackets must be positioned accordingly for a B-pillar which is farther back from the driver. These positionings become a factor for the driver when he/she makes fore and aft and higher or lower adjustments in the seat.

The provision of the shoulder strap height adjuster and the shoulder strap tension adjuster features would seem to be "must have" design requirements to provide an ergonomically sound design of current safety belts installed with air-ride seats in Class 8 trucks.

7.3.6 Variation in Truck Safety Belt Installation and Other Factors

This ergonomics assessment focused on safety belts. It did not exhaustively examine the combination of all major brands and models of Class 8 trucks and seats used. The following design, installation, and use variables pertinent to driver safety belt use were not evaluated:

- Different truck models and configurations.
- Different seat manufacturers' designs. Did the use of the safety belt and shoulder adjuster mechanism differ or did its performance differ as a function of truck seat design?
- Safety belt design differences, old seats versus new belts.

7.4 ADDITIONAL ERGONOMICS AND HUMAN FACTORS CONSIDERATIONS

7.4.1 Ride Quality and Comfort Factors

In all motor vehicles, including Class 8 trucks, there are many seat design features that interact with the issues relating to use or non-use of safety belts. Insofar as seat design affects drivers' perceptions of ride quality, the seat design features also impact the likelihood of whether or not a driver will wear his/her safety belt, and if so, perceive that he or she is wearing it comfortably.

Truck drivers seated in their cabs are exposed to WBV and are affected by seating dynamics (suspension, springs, vertical stroke, lateral movement, etc). The dynamic response of the seat can be the factor most easily used to control human exposure to WBV. Seats can increase as well as decrease vibration experienced in the driver's position.

7.4.2 Interaction of the Air-ride Seats and Safety Belt Use

Three-point truck safety belts are anchored to the truck cab B-pillar wall behind the driver's left shoulder as he/she sits facing the front of the truck. Consequently, when the air-ride seat bounces up and down on its suspension to dampen or attenuate the WBV exposure to the driver, the shoulder belt tends to chafe the neck and shoulder as the strap slides across the driver's upper torso. Additionally, the lap belt may expand or contract, even tighten around the driver's waist as the air-ride seat bounces up and down. This interaction of the safety belt (lap belt and shoulder harness strap) with the air-ride features

can be especially disconcerting to a very large, heavy-set driver who is attempting to wear his/her safety belt comfortably. If during a bounce, or jostling around, the belts/straps cinch tight, this can become very bothersome to the driver, and it will warrant considerable driver complaints.

7.4.3 Quick Egress from a Truck Cab in a Crash Sequence

One common reason for not wearing a safety belt given by truck drivers was their desire to have control over enacting a "quick egress" from the truck cab during a crash sequence. From a human factors and ergonomics perspective, there was a question as to how difficult that was or how time-consuming it was for drivers to unfasten their safety belts and extricate themselves from the cab.

The research team did not find significant research data on this topic.

7.5 NEW TECHNOLOGIES FOR TRUCK SAFETY BELT COMFORT AND USER-FRIENDLY DESIGN

Several new technological innovations are under consideration for use in Class 8 truck seat and or safety belt designs. Several designers of safety belts for trucks have worked on user-friendly design features to make them more comfortable to use. For example, some safety belts are being designed with a softer edge to the strap (belt) webbing or with different stitch designs to provide better energy load limiting (Clancy 2004). There have been experiments conducted on the use of electric retractors for the excess material of the belt when the driver permitted too much slack during use (Clancy 2004). Some safety belt manufacturers are working on improving belt routing and improving the latch-plate-to-buckle interface design (Sickon 2004). Some safety belt designers use a low-friction D-ring for the belt to pass through on the wall anchor point, making the D-ring height adjustable. Some others are considering illuminated buckles to make them easier to locate in a crash sequence or at night (Sickon 2004). Insofar as they involve additional ergonomics and human factors engineering principles, some of the technological approaches to subsequent seat and safety belt design are outlined here.

7.5.1 Seat-Integrated Belts

Eventually, truck seat designers might work with those who design safety belts to produce a safety belt system designed as an integral part of the seat assembly itself—the so-called Seat-Integrated Belt (SIB) design. SIBs are reportedly widely available as a purchase option by OEMs in Europe, where a large percentage of the large trucks are of the Cab-Over-the-Engine (COE) design. This design is substantially different from the more conventional truck design commonly found in the United States. According to Parker (1997), integrated safety belts were much more comfortable for drivers, particularly for those riding on air-ride seats because in the older safety belt design, the belts were attached to the cab frame and rubbed the driver's person as the seat moved up and down.

Proper installation of SIBs in the United States would require modifications to existent truck cab design to strengthen the cab floor to support the SIB and seats would have to be designed to withstand the loading throughout the seat frame itself (Clancy 2004, Sickon 2004). The requirements for seat anchorage in Europe are only about half the strength requirements of the U.S. market, and the design criteria for survivability of higher speed crashes must be more stringent. Proper sled tests to verify design features and crash sequence characteristics would have to be accomplished.

7.5.2 Safety Belt Tensioners

Typically, when a driver wears a safety belt, it is not worn tightly around the waist and upper torso (shoulder straps). During a crash sequence, it is important that the belts be immediately tightened to start absorbing the driver's energy and slow down body movement (McNamara 1997a and b). Therefore, another relatively new design feature under study in passenger car safety belt design is the use of pre-tensioners for safety belts to automatically take up the slack in a belt in milliseconds at the moment of impact and thus couple the driver or seat occupant to the seat quicker during the crash sequence (McNamara 1997, Prentkowski 2004). One of the important functions of pre-tensioners is to help reduce femur load—the load one gets on the knees from being thrust into the instrument panel. They also provide additional protection in rollovers, because they keep the driver cinched down to the seat. In those vehicles, the pre-tensioners are sometimes activated by the same electronic sensors as those used for air bag impact sensors (Prentkowski 2004, Gorton 2004, and Sickon 2004). There are three types of pre-tensioners—retractor pre-tensioners, buckle pre-tensioners, and lap anchor pre-tensioners—that are being evaluated for transfer from passenger cars to trucks (Prentkowski, 2004).

7.5.3 Airbags and Safety Belts in Trucks

Safety belts perform another valuable role by keeping the occupant properly positioned in front of an airbag during a crash sequence (McNamara 1997). This is becoming more important as more OEMs offer air bags in their heavy trucks. For example, airbags can significantly reduce head injuries by preventing a driver who is wearing a safety belt from hitting his/her face on the steering wheel.

Currently, installation of an air bag in front of the truck driver is available as an optional purchase on many of the newer trucks. Such driver air bags are designed to inflate only in high-impact, frontal collisions. If a driver is wearing

his/her safety belt properly, and his/her body is positioned with the back against the seat back, with the head upright, so as to maintain a safe distance from the inflating air bag, the air bag will provide additional protection to the driver in such severe frontal collisions.

In the United States, widespread use of a SIB, the routine use of pre-tensioners, or universal use of airbags would require coordination and agreement among seat designers, safety belt designers, safety engineers, and the OEMs who routinely install such combinations in the trucks they sell. Ultimately, it will be incumbent upon customers to decide to buy such improved, but likely more expensive seats, safety belt combinations, and safety features like air bags. At this point in time, SIBs are considered to be a premium cost item in the U.S. trucking industry. Frontal air bags are considered optional on some trucks, and pre-tensioners are not yet widely embraced.

7.5.4 Adaptive Occupant Protection Systems

Proponents of designing airbags for safer trucks are also examining the use of adaptive occupant protection systems in trucks including sensors that detect how big the occupant (truck driver) is, where he/she is in the seat, and whether or not the driver or a passenger is wearing his/her safety belt. Exploratory work continues on these features.

7.5.5 Safety Belt Use Warning Signals

Automatic shoulder harness latching, use of auditory warning chimes, flashing light reminders, or engine start interlock-out mechanisms have either been explored or implemented for use in passenger cars (Howell et al. 2003, and personal communication with William Howell, November 2004). Some—like the automatic shoulder belt latch—were tried and later abandoned. Many of these technological innovations could be adapted from the passenger vehicle industry with only modest adjustments for trucks (e.g., auditory warnings and buzzers to remind drivers to put on the safety belt). However, given the differences of the Class 8 truck driver's work expectations and differences in CMV driver culture characteristics, there does not appear to be significant activity throughout the trucking industry to either explore or implement many of these features into Class 8 trucks (Sickon 2004).

7.6 ERGONOMICS ASSESSMENT CONCLUSIONS

The research team concludes the following regarding the ergonomic and technological issues relating to safety belt use by CMV drivers:

- Technological efforts need to be focused on comfortable safety belt use by very large, heavy, even obese drivers and by small-statured drivers.
- OEMs who produce and sell Class 8 trucks should consider adopting safety belt design features that permit comfort latches and height adjusters.
- Educational efforts directed at drivers to understand safety belt comfort features should be intensified.
- Further ergonomics and human factors research should be undertaken on the various design and interface variables for different brands and models of trucks and seats and safety belts.

CHAPTER **8**

CONCLUSIONS, SUGGESTED PRACTICES, AND RECOMMENDED RESEARCH NEEDS

8.1 CONCLUSIONS

The research team believes this research project supports the following conclusions that can help guide future efforts to remove the barriers to safety belt use by CMV drivers and encourage increased use:

- The benefits of safety belt use are well understood and appreciated by CMV drivers.
- Usage rates are high in cases where top management is committed to driver safety belt use and encourages, enforces, and provides rewards for belt use.
- Safety belts that are generally available have features that can make belt use comfortable and convenient for most drivers.
- Safety belt and truck manufacturers are taking steps to further improve the convenience and comfort of safety belts.

The principal barriers and factors that are holding back higher rates of safety belt use are the following:

- Drivers have a cultural or factual misperception about the risks of not wearing belts in normal every day use or in emergency egress situations.
- Fleet managers do not employ active, comprehensive approaches to improving safety belt usage rates.
- Some operational situations such as multi-stop, short distance driving and delivery environments lead to situations where drivers give in to a perceived inconvenience or hassle of disciplined, persistent use of belts.
- Large- and small-statured drivers experience discomfort with current safety belt features.
- Drivers are not aware of the comfort features available with modern belts installed on their vehicles.
- Not all fleets insist on the most advanced belts when they purchase their vehicles.

The research team believes that the barriers to increased safety belt use can be bridged by such intensive educational and technological developments as follow:

- Deepen driver understanding of the values of 100% safety belt use and the risks of non-use.
- Ensure that fleet managers employ all available methods to provide incentives for their drivers to use safety belts as a basic and constant feature of their driving activity.
- Accelerate installation of full-featured safety belts in all fleet vehicles.
- Focus on eliminating the discomfort and inconvenience that large- and small-statured drivers associate with current safety belt designs.

8.2 SUGGESTED PRACTICES

8.2.1 General Suggested Practice Concepts

As noted in Chapter 3, the fleet manager survey respondent group was not a random sample of the industry but rather a group of safety-conscious managers (e.g., those who are active in state association safety councils). These safety-conscious managers employed, on average, at least eight different surveyed methods of promoting safety belt use. These fleets typically have written policies requiring safety belt use, include this policy in their driver handbooks, discuss belt use during safety meetings, post signs in offices and terminals promoting belt use, and directly observe drivers' belt use when they are at company terminals. These companies also typically require *all* their employees, including supervisory and administrative personnel, to wear safety belts while on duty at the company. This consistent but multi-pronged approach seems necessary to continually reinforce company policy regarding safety belts as well as to convince drivers of the personal benefits.

Of various government/industry methods to promote safety belt use, fleet manager respondents gave the top rating to video demonstrations of the occupant kinematics of safety belt use and non-use during crashes. Such videos can show the violent movement of unrestrained truck occupants during severe impacts and during rollovers, as well as the safety bestowed by belt use. Respondents also commented that drivers needed to be convinced by statistics proving the safety benefits of belt use. The combination of action demonstrations with statistics may help to counter persistent myths about safety belt use, such as the myth that entrapment in vehicles due to belt use is a likely outcome in large truck crashes.

8.2.2 Motivating Drivers

The research team's analysis of motivational approaches to increasing driver understanding and acceptance of 100% safety belt use includes the following approaches to fleet management strategies and practices:

- When possible, use small discussion groups when talking about safety-belt use. By keeping discussion groups fairly small, driver involvement and commitment will likely increase.
- Try to involve family members and coworkers as much as possible; they can be a valuable source of motivation and support.
  - Use company events to obtain family support and involve family members.
  - Describe safety initiatives and progress in newsletters sent home to the driver's family.
- Be specific and carefully explain all company policies, procedures, and consequences regarding safety belt use.
- Obtain personal testimonies from company drivers who have survived crashes because of their safety belt use. Encourage these discussions at safety meetings.
- Be ready with statistics about the actual safety benefits of belt use for those drivers who may believe falsely that safety belts do *not* increase safety.
- Do not assume that drivers are influenced only by monetary or other material consequences. Appeal to their professional pride and encourage them to make a safety personal commitment to 100% belt use.
- Consider making mandatory use of safety belts a condition of employment. Some fleets find this effective, while some use punitive disciplinary actions only if other approaches have failed.
- When possible, allow employees to take an active role in safety decisions, thereby increasing their feelings of empowerment and self-control. For example, allow employees to discuss and have a choice in the methods used to promote safety belt use.
- Obtain management support and participation.
  - Include company management and non-driver employees in safety meetings and events.
  - Have fleet management and other employees set an example by always wearing their belts.

8.2.3 Suggested Practices Model

The research team explored suggested practices concepts with fleets with successful safety belt programs. These suggested practices have led to substantially increased commitment on the part of drivers to virtually 100% use of safety belts while the drivers are operating their vehicles. The practices may not suit every fleet situation but are offered as suggestions to remove barriers to safety belt use and increase current usage rates.

The first step to benchmarking safety performance is for a fleet to understand its relative position in terms of key performance metrics. In this case, average truck driver safety belt usage expressed as a percentage. Once a fleet understands where it fits relative to the average, the next step can be taken, that is, selecting one or more appropriate interventions from the following list. The list is comprehensive enough to provide options that will fit almost every type of fleet operation, regardless of that fleet's individual culture. For larger fleets, it will also be desirable to internally benchmark by looking at different usage rates from one terminal location to another. It may be that there is already a "best practice" location within the fleet whose practices can be duplicated at multiple locations.

- Equip all power units with belts that are colored safety orange or another bright color for more visibility. This type of change should be well communicated before implementation. Another approach observed by the research team ergonomist was requiring drivers to extend the belt over the steering wheel and exit the cab by the passenger door. When reentering the cab, the driver easily reattached the safety belt.
- Add a safety belt item to pre-trip inspections. Specifics should include that the belt be there, working, and clean and have both a lap and a shoulder belt. An added benefit of bright-colored safety belts is that they are easier to keep clean because dirt is more visible on them.
- Develop a comprehensive company/corporate policy that includes an overview, driver and management responsibilities, training, and enforcement/progressive discipline. Be sure it includes all employees, not just CDL holders. "This policy applies to all employees and all occupants of vehicles driven by employees on official company business, whether in company-owned vehicles, rented vehicles, or an employee's vehicle."
- Have all drivers sign a pledge to use safety belts after completing initial training.
- Develop a strong management "walk the talk" program. Employees will be more likely to mimic what their managers do rather than what they say. One way to test management commitment is to have a safety belt check at the entrance to the corporate headquarters. One fleet had a local police officer and a senior vice president (chief executive officer might be better) at the company entrance issuing "dummy" tickets to anyone not wearing a safety belt as he/she entered the property. Publish the results. Repeat as needed. Be prepared to discipline your best salesperson for failure to observe the law/corporate policy to the same degree as you would your CDL drivers.
- If a fleet had one or more fatal or serious injury accidents where the driver was or was not wearing his/her safety belt, the fleet can use non-privileged information from the accidents to convince all other drivers to wear their safety belts (e.g., displaying wrecked trucks on a flatbed, showing videotapes of accident scenes, or having drivers give testimonials.)

- Develop a comprehensive communication program about safety belt use. Use the marketing communication department (if the fleet has one) to help. The goal is to get the message out in multiple ways. Elements might include initial and follow-up training, company newsletter articles, pep talks, posters, paycheck mailers, or simple reminders by dispatchers. Something new should come out about every 3 to 6 months.
- Schedule a safety day around the safety belt theme. Use a committee of employees to develop a creative program such as having a children's coloring contest or having the state police bring in "the convincer"—a sled type device that lets people see what it feels like to come to a sudden stop at 5 mph.
- Implement a behavioral safety program using employee peer observations and self-observations to check compliance. (These can be fairly complex. The fleet manager may need outside help.)
- Implement a "one strike and you're out" disciplinary process. Like dealing with drugs and/or alcohol, the consequences of not wearing safety belts are serious enough that fleets have been able to gain full buy-in by drivers and driver organizations in this practice.
- Regularly publish dollar amounts for fines paid by company drivers who were cited for not wearing their safety belts.
- Reproduce newspaper and magazine articles on safety belts. Distribute to drivers.

8.3 RECOMMENDED RESEARCH NEEDS

While there is substantial literature on safety belts in automobile use and growing information on usage in the CMV driver environment, the research team believes additional research in the following areas can enhance progress toward significant increases in CMV driver safety belt use:

- Develop a methodical, periodic, and statistically sound methodology for measuring safety belt use among CMV drivers. The methodology should account for differing operational types, locations, and driving situations. A credible measuring approach is essential for determining the current baseline of usage rates and for gauging progress toward a chosen goal.
- As suggested in Chapter 7, perform investigations on the ergonomics interaction of seats, belts, and other comfort features of vehicles to simplify safety belt use and provide user-friendly safety belt operation.
- Perform additional BBS studies to determine the most effective means for motivating drivers to use their safety belts.

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Note: References for Appendix E of this synthesis are included in Appendix E.

APPENDIX A

PROJECT STATEMENT OF WORK

This appendix has not been edited by TRB.

(Note: the following also includes the enhanced Statement of Work which was approved for conduct of this synthesis.)

TITLE: Commercial Motor Vehicle Driver Safety Belt Usage Synthesis Study

SUBMITTED BY: Janet Kumer, Federal Motor Carrier Safety Administration (FMCSA), Office of Communications, Outreach Division (MC-CMO)

BACKGROUND

FMCSR (49 CFR 392.16) requires the use of safety belts by commercial motor vehicle drivers (CMV). In 2003, FMCSA completed a safety belt usage study about truck drivers. A total of 3,909 trucks were observed. The overall safety belt usage rate for commercial vehicles observed in the study was 48 percent. This compares to a usage rate of 79 percent for all passenger vehicles (U.S. DOT National Occupant Protection Use Survey (NOPUS) Survey, June 2003).

FMCSA does not currently have motivating factor data about CMV driver safety belt usage. Additional information is needed about the CMV truck driver population and about motor carrier company safety belt usage requirements, to determine the most effective means of improving safety belt usage.

FMCSA has developed a CMV safety belt improvement program and will use its 2003 study as an indicator that a problem exists concerning low use of safety belts by CMV drivers. Additional usage studies will be required to obtain a more precise baseline against which future enforcement and education/outreach activities will be evaluated.

These studies will provide more information than exists now about our target driver audience and will identify motivating factors for their wearing or not wearing safety belts. Obtaining this information will assist the agency in developing and implementing enforcement and education/outreach strategies to improve safety belt usage among CMV drivers.

SCOPE OF WORK

FMCSA through the Office of Research and Technology is requesting the Transportation Research Board (TRB) conduct a synthesis study and identify best practice techniques used by transportation managers to increase the use of safety belts among commercial motor vehicle drivers. Additionally, the synthesis study will explore the industry to identify why CMV drivers do or do not buckle up.

In order to develop the best education and outreach enforcement program to improve the usage of safety belts (currently 48% usage) by commercial motor vehicle drivers, the FMCSA needs to (1) to locate and assemble documented information regarding driver motivations (i.e., why they do and do not wear safety belts) and motor carrier operation programs and best practices in regard to safety belt use; (2) to learn what practice has been used for solving or alleviating this problem of not using safety belts; (3) to identify all ongoing research on safety belt use by commercial motor vehicle drivers and motor carrier operations to encourage use of safety belts; (4) to learn what problems remain largely unsolved; and (5) to organize, evaluate, and document the useful information that is acquired.

FMCSA is seeking a clear picture of what the motor carrier industry is doing to encourage/discourage the utilization of safety belts. This includes a cross sector representation including but not limited to: tankers; large fleets, small fleets, independent owner operators, private carriers, motor coach carriers, short haul operators and unionized motor carriers and drivers.

FMCSA needs to obtain motor carrier policies and procedures in regard to improving safety belt use. FMCSA needs information regarding what works and what does not work in the areas such as: technology, driver motivation techniques, motor carrier procedures, operations and training.

FMCSA expects results from focus groups and surveys of CMV drivers and motor carrier management.

FMCSA understands anecdotally that some CMV drivers do not wear safety belts because of discomfort associated with the belt (i.e., how it is installed, length of belt, etc). FMCSA is interested in

identifying safety belt mechanisms used in various large truck cabs of the major truck manufacturers and any problems associated with these belts or the manner in which they are installed.

FMCSA's Safety Belt Improvement Plan for CMV drivers encourages industry associations to conduct driver surveys to determine why some CMV drivers wear safety belts and others do not wear safety belts. For instance, the plan mentions the possibility of OOIDA conducting a follow-up survey to the one they conducted in 2001. Additionally, the plan encourages industry associations to conduct motor carrier (company) surveys to determine best practices of motor carriers to identify why some CMV drivers wear safety belts and others do not wear safety belts. For instance, Praxair Inc., a private motor carrier, requires all its CMV drivers to wear safety belts and penalizes those it finds not wearing them. FMCSA expects these surveys to be completed at approximately the same time the synergy study is completed.

Motor carrier stakeholders may be less critical of research generated by FMCSA than on similar research performed by potentially biased industry organizations. For this reason, partner research will be used only to corroborate what FMCSA learns from its own research, not as the foundation upon which to base its education and outreach activities.

The recommended driver and motor carrier surveys and the TRB Synthesis Study are scheduled to be completed during the same timeframe. Potential double surveying may cause confusion with drivers and carriers. Therefore, FMCSA is amenable to the idea of the TRB Synthesis research team coordinating the survey development and deployment with the industry.

SYNTHESIS AUDIENCE

- Commercial motor vehicle carriers and drivers regulated by the FMCSA
- Federal agencies
  - FMCSA
  - National Highway Traffic Administration (NHTSA)
- State highway agencies
- Motor Carrier Safety Assistance Program (MCSAP) agencies
- State legislators
- U.S. Congress
- Motor carrier and motor coach associations
- CMV driver associations,
- Enforcement organizations
  - Commercial Vehicle Safety Alliance (CVSA)
  - International Association of Chiefs of Police (IACP)

INFORMATION SOURCES

- Other countries' motor carrier transportation programs
- Motor Carrier and Motor Coach Associations
  - American Trucking Associations (ATA)
  - National Private Truck Council (NPTC)
  - National Tank Truck Carriers (NTTC)
  - Motor Freight Carriers Association (MFCA)
  - American Bus Association (ABA)
  - International Association of Chiefs of Police (IACP)
- Driver Associations
  - Owner Operators Independent Drivers Association (OOIDA)
  - Teamsters
- State MCSAP agencies
- Enforcement organizations
  - CVSA
  - IACP
- Academic studies
- Manufacturers of commercial trucks and safety belts
- National Highway Traffic Safety Administration (NHTSA)
- IMMI

ENHANCED SCOPE OF WORK FOR MC-08

CTBSSP—Safety Belt Use by Commercial Vehicle Drivers

In the Proposed Work Plan for Project Number MC-08—Synthesis Report on Commercial Vehicle Driver Safety Belt Usage—submitted on May 15, 2004, the MaineWay Services Team suggested an expanded effort for the Project to provide a wider and deeper sample of fleet manager and driver opinion, and a more extensive ergonomic assessment. Based on the suggestions in the Work Plan, the Team expanded its efforts as follows.

Driver Interviews

- The *initial proposal* planned structured interviews at one or two truck stops or weigh stations, reaching approximately 100 drivers.
- The *enhanced proposal* will include the following.
  - Structured interviews at a minimum of four truck stop sites in the South, Midwest and possibly the Northwest, including several additional days of effort. The effort would consist of day long presence by the interviewer at the selected truck stops. Each interview would take from 5–10 minutes, as required to go through the question list
  - A target population of at least 400 drivers
  - Use of an incentive approach utilizing a pre-paid telephone card for 10 minutes of call time
  - Additionally, the Team will consult with the Teamsters to ensure that available driver population lists are utilized

Fleet Manager Surveys

- The *initial proposal* planned a limited survey population of safety and operational managers which would not yield significant disaggregation of data by operation type, fleet size, or other factors.
- The *enhanced proposal* will
  - Include a broader sample approach as follows:
    - Approximately 500 fleet managers will be surveyed, with the objective of a resulting return of 200 responses. These will be targeted through a focused mailing using ATA, NPTC, National Tank Truck Association, Truckload Carriers Association, Motor Freight Carriers Association lists.
    - Initial written returns will be monitored and evaluated in relation to return targets. The Team will then supplement the initial mailing, as needed using blast fax, and on-line survey techniques with a broader population including state associations to bring the return to the desired level.
  - Provide disaggregation of survey results by categories including Private Fleets, For-hire fleets distinguished by Truckload and Less than Truckload groups, Specialized Carriers, Couriers, and Bulk Carriers, assuming a minimum of 10 respondents in these categories.

Group Interviews

- The *initial proposal* did not include group interviews.
- The *enhanced proposal* will include
  - Group Safety manager interviews as follows:
    - A meeting with managers at the conference of the Safety and Loss Prevention Managers Council
    - A structured conference call with the NPTC Safety Committee
    - A meeting with safety managers organized through the Motor Freight Carriers Association
    - A planned meeting with a Praxair terminal manager
  - Group Driver interviews as follows:
    - A conference call with the ATA Road Team Captains
    - Separate group sessions during the National Truck Driving Championship in Minnesota
    - A group of Praxair drivers

Targeted Discussion Sessions

- Jerry Krueger will include a safety belt usage discussion topic in a series of otherwise planned training sessions for Health and Wellness through an FMCSA/ATRI program over the next several months.

Focused Ergonomics Review

- The *initial proposal* was limited to a literature review and ergonomic factors identified in the interview processes.
- The *enhanced proposal* will include the following, broader range of activities:
  - A "hands-on" ergonomics evaluation including physical inspection, examination, and operation of from 3–4 different types of safety belts utilized in commercial vehicles.
  - Use of commercial drivers in test locations, to provide live operational demonstration trials of the range of safety belts.
  - Coordination and discussion with several original equipment manufacturers relating to choices of safety belt suppliers. This will occur with the cooperation of the Truck Manufacturers Association, which has volunteered to assist in this aspect of the analysis.
  - Contacts and discussions with 2–3 vendors of commercial vehicle safety belts regarding their research programs and other strategies regarding safety belt design.
  - Focused analysis of ergonomics related questions in driver and fleet manager interviews.

APPENDIX B

FLEET MANAGER SURVEY

This appendix has not been edited by TRB.

FLEET MANAGER SURVEY

Safety Belt Use by Commercial Drivers

This survey, which takes about 15 minutes to complete, focuses on commercial (large truck & bus) driver use of safety belts. Thanks for your participation and support!

Part 1: General Questions

1. Do **you** wear safety belts at work and in your private vehicle? *Circle oae*:
1a. At work: never rarely about half the time usually always
1b. In your private vehicle: never rarely about half the time usually always

2. Please ***estimate*** the following percentages (to the nearest 10%) to the best of your ability:
2a. What percent of ***all*** U.S. commercial drivers wear safety belts in their trucks and buses? Answer: _____% [answer to nearest 10%].
2c. What is the overall percentage of safety belt use among ***your fleet's*** **drivers** on the job? Answer: _____%.
2d. Do federal regulations ***require*** CMV drivers to wear safety belts on the job? Circle one: yes not sure no.

3. Below is a list of possible reasons for ***not*** wearing safety belts in trucks and buses. Of your drivers who ***do not*** wear safety belts or ***don't always*** *wear* them, what reasons do they give? *Circle up to three (3) choices*:

a. Too much trouble & effort
b. Just forget
c. Habit
d. Belt does not fit well
e. Uncomfortable for other reasons
f. Restricts movement in vehicle (e.g., can't see mirrors well)
g. Infringement on personal freedom
h. Worried about being trapped in vehicle (e.g., in a fire, or submerged in water)
i. They don't believe that belts increase safety
j. Just don't like them.
k. Part-time users; e.g., use them only during bad weather or on the highest speed roads.
l. Frequently getting in and out of cab makes use inconvenient.
N/A. <u>All</u> our drivers <u>always</u> wear safety belts.

4. Consider the drivers in your fleet who do **not** wear safety belts regularly. Compared to other drivers, do these driver tend to engage more often in unsafe driving practices such as speeding, tailgating, and violations of regulations and company rules?
Circle one: Yes Not sure No.

Part 2: Fleet Methods to Promote Use

Instructions for below: Circle YES for each approach your company follows to promote use of safety belts. **If** you circle YES, then rate your perception of its level of effectiveness in promoting belt use by circling the appropriate number.

				If "Yes," please rate effectiveness.			
			Highly Ineffective	Ineffective	Not Sure/Neutral	Effective	Highly Effective
5. Post signs in office/terminal and/or driver room.	Yes	No	0	1	2	3	4
6. Post signs in vehicles	Yes	No	0	1	2	3	4
7. Ask candidates during selection interviews or in questionnaires	Yes	No	0	1	2	3	4
8. Discuss during safety meetings	Yes	No	0	1	2	3	4
9. Written company policy requiring use	Yes	No	0	1	2	3	4
10. Printed handouts (e.g., brochures)	Yes	No	0	1	2	3	4
11. Media training aids (e.g., videos, slides)	Yes	No	0	1	2	3	4
12. Observe driver belt use in vehicles (e.g., when drivers are at office or terminal)	Yes	No	0	1	2	3	4
13. Punishment/reprimands for non-use	Yes	No	0	1	2	3	4
14. Rewards/recognition for observed use	Yes	No	0	1	2	3	4
15. Post statistics on fleet use (e.g., % use)	Yes	No	0	1	2	3	4
16. Testimonials by experienced drivers who avoided injury by using belts.	Yes	No	0	1	2	3	4
17. Consistent emphasis of belt use for all employees, including supervision.	Yes	No	0	1	2	3	4
18. Change all safety belts to safety orange or other bright color.	Yes	No	0	1	2	3	4
19. Encourage employees to report drivers not wearing safety belts.	Yes	No	0	1	2	3	4
20. Policy included in Driver Handbook.	Yes	No	0	1	2	3	4

			If "Yes," please rate effectiveness.				
			Highly Ineffective	Ineffective	Not Sure/Neutral	Effective	Highly Effective
21. Driver use of safety belt included as part of accident investigation process.	Yes	No	0	1	2	3	4
22. Coffee mugs, key rings, etc., with safety belt messages.	Yes	No	0	1	2	3	4
23. Other method or practice? (specify) _____							

Part 3: Government/Industry Programs to Promote Use

Instructions for below: Please rate the general effectiveness of the government/industry methods or approaches listed below that might be used to promote belt use.

	Highly Ineffective	Ineffective	Not Sure/Neutral	Effective	Highly Effective
24. TV public service announcements	0	1	2	3	4
25. Radio public service announcements	0	1	2	3	4
26. Magazine/newspaper ads (e.g., in trucker publications)	0	1	2	3	4
27. Testimonials by celebrities (e.g., NASCAR drivers) on TV, radio, or in publications	0	1	2	3	4
28. Showing test crashes with crash test dummies, with and without safety belts.	0	1	2	3	4
29. Providing instructional materials to fleets (e.g., slides) for use in safety meetings with drivers.	0	1	2	3	4
30. Active and well-publicized government website promoting safety belt use.	0	1	2	3	4
31. Other suggested methods? (specify): _____					

Part 4: Comments

32. Any comments on commercial driver safety belt use or ways to promote it?

_____

_____

Part 5: Information about You and Your Fleet

33. The approximate number of years you have been a safety manager (for carrier motor operations)? _____

34. Your approximate total years experience in commercial vehicle operations? _____

35. The number of power units currently in your organizations' fleet? _____

36. How would you characterize your fleet's primary operation? (*Circle or underline the operation type that best characterizes your fleet.)*

a. For hire: long haul/truckload
b. For hire: bulk carrier
c. For hire: long-haul/less-than-truckload (LTL)
d. For hire: local/short haul (most trips less than 100 miles from home base)
e. Private carrier: long haul or regional/truckload
f. Private carrier: bulk carrier
g. Private carrier: local/short haul (most trips less than 100 miles from home base)
h. Private carrier: long-haul or regional/less-than-truckload (LTL)
i. Passenger carrier: long haul/motor coach
j. Passenger carrier: local/transit
k. Other: _____

Please mail your survey form in the enclosed self-addressed envelope to: Dr. Ron Knipling, VA Tech, 7054 Haycock Road, Falls Church, VA 22043. Fax: 703-538-8450. E-mail: **rknipling@vtti.vt.edu**.

Should you wish to provide your contact information (as noted on the cover letter), you will be sent a FREE copy of the project final report to be published in Spring 2005, as well as Adobe (pdf) copies of two completed reports relating to carrier safety management.

Thank you again for your participation in this study!

APPENDIX C

DRIVER INTERVIEW GUIDE

This appendix has not been edited by TRB.

Introduction: "ATRI is working to better understand the use of safety belts by truck drivers through the feedback of drivers themselves. As a truck driving professional, I was wondering if you could offer your input to this strictly confidential survey."

1. What percentage of the time do you wear a safety belt while driving your truck?

2. What percentage of the time do you wear a safety belt while driving or riding in a non-commercial vehicle?

3. For the above, why do you or don't you choose to wear a safety belt?

4. Here are some reasons for not wearing safety belts. Which do you feel are valid?
   a. Too much trouble & effort
   b. Uncomfortable
   c. Forget to put it on
   d. Infringement on my rights/personal freedoms
   e. Worried about being trapped in vehicle if there is an accident
   f. Any other valid reasons?: _____

5. If truck safety belts were more functional, comfortable, and easy to use, would you be more inclined to wear them? **Yes / No**

   [If Yes]: What about your safety belt is uncomfortable or difficult to use? (Circle all that apply.)
   A: Limited range of arm and shoulder motion
   B: The lap belt or shoulder harness is not long enough/too tight
   C: Shoulder harness position is awkward
   D: The belts ride too high or too low
   E: Other: _____

6. What are your biggest complaints about safety belts?
   (*Ask regardless of whether the subject wears a safety belt*):

7. In your experience, what makes a safety belt easy to use? (*Check if applicable, do not offer the below descriptions.*)

	It does not fit too tight
	It does not interfere with my driving
	It is easy to put on/take off
	It is easy to position
Other	
Other	

8. What could potentially make a safety belt less difficult to use?

9. Does your company have a policy requiring drivers to wear safety belts?
   1) Yes 2) No 3) Uncertain

10. [**If yes**] If you violated this policy, would there be a negative consequence, e.g., a reprimand?

11. Has your company ever offered drivers any kind of reward or positive recognition for wearing their safety belts, or offered any educational courses on safety belt use?

12. What type of incentives do you feel would motivate drivers to wear their safety belt more often?

13. Information about you.
    - c Years driving commercially:
    - c Is your fleet:
      - b Long haul vs. local/short haul (50 miles)
      - b For-hire vs. private
      - b (If for-hire) Operation type:
        1) Truckload 2) LTL 3) Specialized 4) Tank Truck 5) Courier
      - b Principal cargo:

14. *Estimates to be collected by the interviewer:*

Height: *a. Under 5 feet*
b. 5′1″ to 5′6″
c. 5′6″ to 6′
d. 6′ to 6′6″
e. Over 6.6″

Weight: *a) 100–150 lb* *b) 150–200 lb*
c) 200–250 lb *d) 250–300 lb* *e) 300+ lb*

Age: *a) 21–35*
b) 35–50
c) 50+

Gender: *a) Male*
b) Female

APPENDIX D

DRIVER FOCUS GROUP INTERVIEW GUIDE

This appendix has not been edited by TRB.

Introduction: "ATRI is working to better understand the use of safety belts by truck drivers through the feedback of drivers themselves. As a truck driving professional, I was wondering if you could offer your input to this strictly confidential survey."

1. What percentage of the time do you wear a safety belt while driving your truck?

2. What percentage of the time do you wear a safety belt while driving or riding in a non-commercial vehicle?

3. For the above, why do you or don't you choose to wear a safety belt?

4. Here are some reasons for not wearing safety belts. Which do you feel are valid?
   a. Too much trouble & effort
   b. Uncomfortable
   c. Forget to put it on
   d. Infringement on my rights/personal freedoms
   e. Worried about being trapped in vehicle if there is an accident
   f. Any other valid reasons?: _____

5. If truck safety belts were more functional, comfortable, and easy to use, would you be more inclined to wear them? **Yes / No**

   [If Yes]: What about your safety belt is uncomfortable or difficult to use? (Circle all that apply.)
   A: Limited range of arm and shoulder motion
   B: The lap belt or shoulder harness is not long enough/too tight
   C: Shoulder harness position is awkward
   D: The belts ride too high or too low
   E: Other: _____

6. What are your biggest complaints about safety belts?
   (*Ask regardless of whether the subject wears a safety belt*):

7. In your experience, what makes a safety belt easy to use? (*Check if applicable, do not offer the below descriptions.*)

	It does not fit too tight
	It does not interfere with my driving
	It is easy to put on/take off
	It is easy to position
Other	
Other	

8. What could potentially make a safety belt less difficult to use?

9. Does your company have a policy requiring drivers to wear safety belts?
   1) Yes 2) No 3) Uncertain

10. [**If yes**] If you violated this policy, would there be a negative consequence, e.g., a reprimand?

11. Has your company ever offered drivers any kind of reward or positive recognition for wearing their safety belts, or offered any educational courses on safety belt use?

12. What type of incentives do you feel would motivate drivers to wear their safety belt more often?

13. Information about you.
    - Years driving commercially:
    - Is your fleet:
      - Long haul vs. local/short haul (50 miles)
      - For-hire vs. private
      - (If for-hire) Operation type:
        1) Truckload 2) LTL 3) Specialized 4) Tank Truck 5) Courier
      - Principal cargo:

14. *Estimates to be collected by the interviewer:*

Height: *a. Under 5 feet*
b. 5′1″ to 5′6″
c. 5′6″ to 6′
d. 6′ to 6′6″
e. Over 6.6″

Weight: *a) 100–150 lb* *b) 150–200 lb*
c) 200–250 lb *d) 250–300 lb* *e) 300+ lb*

Age: *a) 21–35*
b) 35–50
c) 50+

Gender: *a) Male*
b) Female

APPENDIX E

OVERVIEW OF NHTSA PASSENGER CAR CAMPAIGN

This appendix has not been edited by TRB.

Background: 1950–1977

Increasing safety belt use (SBU) is an objective that has been pursued in many nations and by many organizations within the United States, particularly by safety and health groups and by the automobile industry. The U.S. Congress has also played an important role at various times over the past 30 years. Certainly, the Highway Safety Act of 1966 was a major milestone for all traffic safety programs as it created the National Highway Safety Bureau, which later became the National Highway Traffic Safety Administration (NHTSA) and it provided for funding to be managed both by NHTSA and the newly created State Offices of Highway Safety (OHS).

In the U.S., safety belts were first installed in vehicles in the late 1950's but their installation in new vehicles was not required until 1968. Efforts to develop and promote the use of air bags, as an alternative means to protect occupants of motor vehicles, was also introduced in the 1960s and formalized with a proposed requirement for such devices in 1969.

Meanwhile, initial public awareness efforts were being implemented, both here and in Australia. Perhaps the most widely known of the early media campaigns in the U.S. was the *"Buckle Up for Safety"* Campaign implemented by the National Safety Council (NSC) in 1968. This was an extensive campaign, the impact of which was not documented in terms of increased SBU. However, NHTSA surveys showed that, as late as 1979, safety belt use (among drivers) in the U.S. was only about 11% (see Goodell-Grivas, 1983, 1987). A geographically smaller effort, initiated in Oakland County, Michigan, resulted in a 3 percentage point increase in SBU (i.e., from 18% to 21%) among drivers and no increase among passengers (Oakland County TIA, 1969). About the same time (1967–69), extensive media efforts were implemented in Australia. These campaigns resulted in usage rates of about 22% (Livingston et al., 1978; Nichols, 1982).

Beginning in the early 1970's, multi-year media efforts were implemented in various European nations. Some of the best recorded campaigns took place in Great Britain, from 1971 to 1978 (Fabry, 1973, Nichols, 1982) and in Sweden from 1971 to 1974 (Edvardson and Degermark, 1976). Support for these efforts appears to have involved a combination of government, safety, and medical organizations, as well as the news media (Livingston et al., 1978; Nichols, 1982). The highest documented SBU rate resulting from such campaigns was 36%, achieved in Sweden in 1974, following a 3-year campaign involving both public awareness efforts and incentives (Edvardson and Degermark, 1976).

At about the same time as the British campaign was being conducted, NHTSA was evaluating the effectiveness of media efforts in three California communities. The Agency found no clear evidence of increases in SBU resulting from media programs of differing intensity (Fleischer, 1973). Finally, later in the decade, an automobile industry group launched an intense paid media campaign in southeast Michigan. This campaign, which included nearly $1 million in paid media in this relatively small geographical area, resulted in a 4–5 percentage point increase in SBU (Motorists Information Inc., 1978). With regard to increasing SBU, the 1970 enactment of the first mandatory SBU law in Victoria, Australia, was likely the most important event of the period. This legislation was followed by similar legislation in all of the Australian states and in New Zealand. The Australian laws resulted in an increase in safety belt usage from just over 20% to about 75% across Australia (Livingston et al., 1978, Nichols, 1982). Similar results were obtained by several European nations which enacted SBU laws. Luxembourg, France, Belgium, Finland, Netherlands, Norway, and Spain all enacted such laws by 1977 and experienced increases in SBU in these European nations ranging from 25% to 75%, with a median of about 45% (Nichols, 1982). Several additional nations (Portugal, Greece, Ireland, Switzerland, and Great Britain) followed by enacting laws prior to the first SBU law in the United States in 1984.

Early efforts were also initiated to encourage mandatory SBU laws in the U.S. NHTSA asked for a concurrent resolution requiring State SBU laws in 1972 and the Congress responded with an incentive program in 1973. At the same time, both the automobile industry and NHTSA continued to conduct research to determine the impact of various vehicle-related approaches to increase SBU. They included more comfortable and convenient safety belt systems; reminders such as buzzers and lights (which resulted in usage rates of about 28% in some 1973 model vehicles), and ignition interlocks (which resulted in usage rates of 60% and above in some 1974 model vehicles). However, there was a negative reaction to interlocks and, in 1974, Congress repealed a 1973 rule requiring them and, in the same year, withdrew the incentive program implemented to encourage States to enact mandatory SBU laws.

At the end of the decade, however, there was a very important event that may have increased the potential for enacting SBU laws in the U.S. In 1977, Tennessee enacted the first child passenger safety (CPS) law. All States followed by enacting such laws by 1985 and, as a result, the use of child safety seats among young children increased from less than 15% to over 50% during that time period.

Finally, it is worth mentioning that, throughout much of its history and particularly from 1970 to 1990, the movement to increase safety belt use (SBU) was also significantly affected by a parallel effort to protect motor vehicle occupants by means of passive restraints, primarily air bags. Both the approach and the intensity of SBU promotional programs were affected by the air bag movement, sometimes in a limiting manner and other times in an enhancing manner. No other nation was affected to the same extent by these two competing approaches to protect motor vehicle occupants.

In summary, there were many domestic and foreign efforts implemented to increase SBU prior to 1978. Legislation in Australia and in several European nations had resulted in substantial increases in SBU but, in the U.S., usage had increased very little. This lack of progress was in spite of a variety of initiatives including vehicle requirements, media campaigns, and a brief incentive program to enact SBU laws.

Increasing Safety Belt Usage: 1978–2004

This historical account of efforts to increase safety belt usage in the U.S. begins in 1978, with the completion of an NHTSA-funded

project to develop a compendium of behavioral approaches for increasing SBU. As a result of this and subsequent efforts, a number of approaches for increasing the use of safety belts have been identified. They include: *public information* (e.g., mass media campaigns); *education* focused on specific target groups (e.g., school-based or employer-based programs); *incentives* and/or *rewards* (e.g., an opportunity to win a prize based on a pledge to buckle-up or receipt of a prize for being observed buckled-up); *requirements* to buckle up (e.g., laws, regulations, or organizational policies requiring SBU); *enforcement* of SBU requirements (e.g., highly visible enforcement campaigns); and *sanctions* (e.g., fines and license demerit points).

In addition, to these behavioral approaches, several vehicle-related approaches for increasing SBU have been identified. They include reminders (e.g., buzzers and lights), interlocks, and safety belt systems that are more comfortable and convenient. Although some of these approaches, such as more comfortable and convenient safety belt systems, have undoubtedly facilitated recent increases in SBU, their impact has not been evaluated independent of behavioral efforts. A recent report by the Transportation Research Board (TRB) reviewed these vehicle-related approaches and their current potential for increasing SBU (Transportation Research Board, 2003).

In 1978, the Congress also required States to allocate a portion their highway funds for programs to increase SBU. This requirement, along with the new NHTSA compendium, provided focus for NHTSA efforts over the next several years. Following is a summary of key periods of change in what has been a relatively continuous effort on the part of NHTSA (and others) to increase SBU.

Because the effectiveness of safety belts, when worn, is well established, the primary objective of most SBU programs has been to increase *observed* use, as measured by the results of observational surveys. The characteristics of such surveys have evolved over time. From the late 1970s to 1991, the primary source of observational data was NHTSA's 19-city survey (e.g., Goodell-Grivas, 1983, 1992). From 1991 through 1994, when nearly all States were conducting statewide observational surveys, national estimates of safety belt usage were obtained by aggregating the results of these statewide surveys. Since 1994, the primary source of observational data has been NHTSA's National Occupant Protection Usage Survey (NOPUS). The results of period NOPUS surveys have been summarized in a number of reports issued by the National Center for Statistics and Analysis (e.g., see NCSA, 1997 and 2001 and Glassbrenner et al., 2004).

1979–1981: Workshops in the States. The first phase of the revitalized efforts to increase SBU involved several series of regional and State workshops initiated by NHTSA. These workshops, which involved representatives of State highway safety officials and key advocacy groups, identified legislation as the most effective demonstrated means for increasing SBU. While one series of workshops, which focused on child passenger safety (CPS), was followed by the introduction of a substantial number of CPS bills introduced in the States, the focus on legislation in the SBU workshops was more muted. These workshops focused more on non-mandatory approaches for increasing usage (i.e., public information, education, and incentives) and on community and employer regulations and policies to require SBU. This limited emphasis on legislation in the SBU workshops was in part due to previous actions by the Congress (e.g., canceling the SBU law incentive program in 1974 and strong language that accompanied this action) and, in part due to the fact that there was not much support for mandatory SBU laws among either the public or State and local officials at the time. At the start of these workshop series, usage among drivers of passenger cars was about 10% and there was no measurable change in usage by 1981 (Goodell-Grivas, 1987).

1981–1984: Outreach and Education. While there was no documented impact of the NHTSA workshops in terms of increased SBU at the time, they provided a background for greatly expanded SBU programs pursued by the Agency from 1981 to 1984. Under a new administration, the Agency implemented an extensive *networking and education* program in 1981 that was designed to enlist the support of public health, medical, education, civic, and service, and other groups (including employers) to encourage *voluntary* SBU among the general public and *mandatory* use among employees. This approach resulted in the enlistment of scores of such organizations promoting SBU in the States and among their own members and employees. There was no stated numerical objective of this program and there was only a modest change in observed SBU as measured by NHTSA's 19-city survey (i.e., observed use increased from about 11% in 1981 to about 14% in 1984). However, it is commonly held that this outreach and education program greatly facilitated subsequent legislative efforts.

During this period, NHTSA also supported a number of evaluations of incentive programs, most often in employer situations, but also in community settings. These efforts resulted in relatively consistent evidence of increased SBU in controlled organizational environments but somewhat less often in more open, community-wide environments (e.g., see Geller, 1982 and Hunter et al., 1986). SBU increases associated with such programs generally declined after the programs were concluded.

1984–87: Intense Legislative Activity in the States. The largest nationwide increase in usage occurred from 1984 to 1987, when 31 States enacted mandatory SBU laws. This legislative movement was initiated by efforts of a medical coalition in New York which resulted in the New York SBU law being enacted in 1984. However, the primary force behind this movement after 1984 was *Traffic Safety Now (TSN),* an automobile industry-funded organization established to push for State SBU laws. This effort was in response to a Supreme Court decision not to require auto manufacturers to install automatic restraints in new vehicles if two-thirds of the population was covered by mandatory SBU laws (with specific minimum requirements). TSN was the primary stimulus behind the legislative activity in nearly all of the States that enacted SBU laws after 1984.

Most of these new SBU laws were *secondary enforcement laws,* as opposed to *primary enforcement laws* which allow a police officer to stop and/or ticket a driver for an observed violation of the SBU law. This legislative "compromise" made such laws harder to enforce and diminished their impact to some extent, compared with the impact of SBU laws in Australia and Europe. On average, States that enacted SBU laws during this period experienced gains in their SBU rate of more than 30 percentage points (Campbell et al., 1987, Dinh-Zarr et al., 2001). But these rates frequently declined to some extent within a year after the laws went into effect. NHTSA supported this legislative movement by providing funding for special evaluations of these early laws. The Agency also continued to promote media, education, and incentive programs in the States. During this period, the national SBU rate increased from 14% in 1984 to 42% in 1987, a 28 percentage point (200%) increase (e.g., see Goodell-Grivas 1987, 1992).

1987–1990: Diminished Legislative Activity and Recognition of a Need for Highly Visible Enforcement. By 1987, 37 States had enacted SBU laws. Seven additional States enacted such laws from 1987 to 1990. As a result, national usage rate increased more modestly, from 42% in 1987 to 49% in 1989. At this time, it was also clear that usage in the States with SBU laws (both primary and secondary) were not as high as the level achieved in foreign nations, particularly in Canadian provinces where highly visible enforcement efforts had resulted in much higher usage rates, some approaching 90 percent (e.g., see Lonero and Pierce, 1981 and Dussault, 1990). In 1987, the Insurance Institute for Highway Safety (IIHS) reported on a highly visible enforcement effort in Elmira, New York, which resulted in an increase in SBU from 49% to 77%, a 28 percentage point increase (Williams et al., 1987). A similar study by NHTSA was conducted in Albany and Greece, New York (Rood, 1987). These two demonstrations, plus the results of Special Traffic Enforcement Programs (STEPS) in Canada, provided the stimuli for an increasing focus on highly visible enforcement as an effective approach for increasing SBU. During this period, there was also a growing recognition of the need to upgrade existing secondary enforcement laws to allow for primary enforcement.

1990–1992: Operation Buckle Down and the 70% by '92 Program. By 1990, there was still much opposition to buckling up. It was recognized that, if increased enforcement was a desired objective, there had to be more effective communication regarding SBU within the enforcement community. As a result an outreach and communications program called *Operation Buckle Down* (OBD) was developed and implemented in the form of grants with States to hire prominent members of the enforcement community (often retired police chiefs, sheriffs, or leaders in the State Patrol/State Police) to become SBU liaisons within the enforcement community. These officers were initially called OBD spokespersons and later called Law Enforcement Liaisons (LELs). Their objectives were to familiarize police officers with the benefits of safety belt use, to increase SBU within the enforcement community, and to enlist the support of enforcement agencies in State and local SBU campaigns.

The first national enforcement campaign was implemented during the summers of 1991 and 1992. It was called the "70% by '92" program and it focused on generating highly visible STEP enforcement programs, similar to campaigns in Elmira, New York, and in the Canadian Provinces. Its stated objective was to reach 70% national SBU by 1992 (from a baseline of approximately 49%). The program involved highly visible enforcement (and media) efforts surrounding the three summer holidays (i.e., Memorial Day, Independence Day, and Labor Day) in 1991 and 1992. National OBD conferences were held twice each year to maximize the energy and focus of the program on a combination of enforcement and media activity. This program generated unprecedented SBU enforcement and media activity in the States and it resulted in an increase in SBU, although the magnitude of the increase is not absolutely clear due to a shift in survey approach. Using NHTSA's 19-city survey, usage increased by 2 percentage points in the first year (from 49% in 1990 to 51% in 1991) but, using a population-weighted average of state surveys, usage increased by about 6 percentage points (from 53% to 59%) during that period. Gains in 1992 were somewhat smaller, increasing from 59% to 62%, according to the weighted aggregate of state surveys (the 19-city survey was discontinued in 1991). Overall, the state-survey aggregate indicated that SBU increased by 9 percentage-points from 1990 to 1992, the second largest increase in U.S. history (Nichols, 1993).

1992–1996: Upgrades to State SBU Laws and STEP Demonstrations. The 70% by '92 Program was followed by a period of reduced enforcement activity in the States as many State and local officials were still were not totally comfortable with highly visible SBU enforcement campaigns. NHTSA continued to support such activity in the form of STEP demonstration programs in 12–20 States over the next several years, but the level of implementation was not as intense in most of these States as it had been in 1991 and 1992, and generally not as intense as in the 1987 Elmira demonstration. An NHTSA evaluation of these efforts found that an average of 5 waves of STEP enforcement resulted in large increases in primary law states (16–17 percentage points) but much more modest increases (5–6 percentage points) in secondary law states (Solomon et al., 1999).

Several States (i.e., California, Louisiana, and Georgia) initiated a rather slow (and continuing) movement among secondary law States to upgrade their laws to allow for primary enforcement. On average, these upgrades resulted in relatively immediate increases in SBU of more than 10 percentage points Ulmer et al., 1994 and 1997; and Preusser and Presser, 1997).

During this period, a new method was introduced for measuring SBU. In 1994, NHTSA implemented the first National Occupant Protection Usage Survey (NOPUS), which was a nationwide probability sample to measure changes in SBU. According to NOPUS, the national SBU rate increased from 58% in 1994 to 61% in 1996 (e.g., see NCSA, 1997).

1996–2000: A Crisis Leads Results in a Call to Action and a Reinvigorated Program. In early 1996, following the highly publicized child deaths associated with deploying passenger-side air bags, there was a National "Call to Action" conference called by NHTSA, NSC, and the National Transportation Safety Board (NTSB) to respond to these deaths. This conference and a subsequent meeting of key stakeholders called by the Secretary of Transportation resulted in the formation of a broad coalition of automobile and child seat manufacturers and suppliers, as well as several major insurance companies. This coalition eventually came to be called the Air Bag and Seat Belt Safety Campaign (AB&SBSC). Based on a review of the research literature (Nichols, 1996), the Campaign adopted a 3-point multi-million dollar program to increase both SBU and CPS. The three primary components of this program were (1) a media and education effort to move children to the rear seat; (2) support for primary law upgrades in secondary law States; and (3) implementation of twice-annual media and enforcement mobilizations (i.e., national STEPs) called *Operation ABC*—**A**merica **B**uckles **C**hildren. Each subsequent mobilization resulted in the participation of a larger number of enforcement agencies across the nation, reaching more than 10,000 agencies pledged to participate by November 2000.

Also in 1996, the President signed an executive order that directed the Secretary of Transportation to work with the Congress, the States, and other concerned groups, including the automobile and insurance industries and safety and health groups, to develop a new plan to increase SBU nationwide. This effort ultimately resulted in the National *Buckle-Up America (BUA)* program, administered by NHTSA. It represented an ambitious new effort with the goal of increasing SBU from 68% in 1996 to 85% by 2000, a 17 percentage point increase. The four elements of the BUA program were (1) public-private relationships; (2) enhanced legislation; (3) high visibility enforcement; and (4) effective public education. One example of the increased emphasis on public-private relationships

involved cooperation with the AB&SBSC in the implementation of its media and enforcement efforts.

Finally, another very important event of this period was the reauthorization of funding for transportation in 1996. In this bill (Section 157, Title 23, U.S. Code), Congress not only provided substantial rewards for States that achieved high SBU rates, it also provided additional funding, in the form of "innovative" grants, for States to improve their SBU rates. NHTSA immediately began to steer these funds into State grants for combined *media and enforcement* efforts to support the ongoing Operation ABC mobilizations. As this effort progressed, an increasing number of States began implementing more intense and visible enforcement efforts, organized at the State level, but coordinated with the national mobilizations.

Associated with these and other activities, including secondary-to-primary law upgrades in Indiana, Alabama, Michigan, and New Jersey, the national SBU rate increased by 10 percentage points during this period, from 61% in 1996 to 71% in 2000 (NCSA, 2001). Although this increase did not meet the ambitious goal of 85% SBU in 2000, it represented steady progress over the period and this progress was associated with State programs that were increasingly focused on highly visible enforcement and were increasingly coordinated with the twice annual *Operation ABC* mobilizations.

2000–2003: A Refocus on *Click-It or Ticket* and on Primary Laws. There are several important aspects of the SBU effort since year 2000 that have been associated with increasing SBU across the nation. One of the most important characteristics of this period is the continued evolution of highly visible STEP programs with increasing emphasis on paid media and "hard" enforcement messaging in the twice annual national *Operation ABC* mobilizations. This phase of the mobilizations actually began with the implementation and evaluation of the South Carolina *Click It or Ticket* (CIOT) program in the fall of 2000. However, it was not until later that multiple states adopted similarly intense and visible enforcement efforts in conjunction with *Operation ABC.* In 2001, eight southeastern States fully adopted the *Click It or Ticket* model; in 2002, more than a dozen States in geographically dispersed regions implemented similar programs; and, in 2003, the majority of States across the nation participated in the national mobilization which was renamed the *Click It or Ticket* mobilization. As a result of these efforts, there have been significant increases in both public awareness and SBU in participating States. Evaluations of these programs generally found statewide SBU increases of 8–10 percentage points associated with these programs (e.g., see NHTSA [2001] regarding the South Carolina CIOT in 2000; Solomon [2002] regarding the CIOT effort in eight Southeastern States in 2001; Solomon et al., [2002] regarding fully implemented STEPs in 12 States across the nation in 2002; and Compton and Solomon [2004] regarding the nationwide CIOT mobilization in 2003). These increases in SBU have generally been associated with significant increases in awareness of SBU messages, enforcement, and slogans (Milano et al., 2004).

Associated with the above efforts, the national SBU rate rose from 71% in 2000 to 79% in 2003. The greatest increase (4 percentage points) took place in 2003 when most States participated in the national CIOT mobilization (Glassbrenner et al., 2004).

2004: The Current Program. Recently, NHTSA reviewed all potential efforts for increasing SBU and created a new strategic plan which focuses on continued efforts to conduct *high visibility enforcement* of safety belt use laws, development of a *multi-year national communications effort* that supports enforcement and other effective means for increasing SBU, expanding its *employer policies and regulations* to increase employee SBU; and improving the *comfort and convenience* of safety belt systems.

Although tracking safety belt usage rates continues via the NOPUS, there is also a new metric for tracking progress. It is called the *conversion rate* and it refers to the percent of SB non-users converted to SB users each year or by each campaign effort. Assuming an 8.5% conversion rate of non-users to users, NHTSA projects an 81% SBU rate by 2005 and an 88% rate by 2010.

Perhaps the most important unfinished business with regard to implementing a maximally effective program to increase SBU is the enactment of primary enforcement laws in all states. Without such laws, a national usage rate above 80 percent will be very hard to achieve. Currently, 21 States plus the District of Columbia and Puerto Rico have such laws. That means upgraded legislation is needed in 28 States with secondary laws and in New Hampshire, which has no adult safety belt law.

TABLE E-1 Program efforts and phases associated with overall increase in SBU

Period	Activity	SBU Change	Measurement
1978–1981	SBU Workshops with the States	none	n/a
1981–1984	Outreach and Education	11% to 14%	19-city Survey
1984–1987	Rapid Expansion of SBU Laws (Vince and Larry Campaign)	14% to 42%	19-city survey
1987–1990	Declining Expansion of SBU Laws (Vince and Larry Campaign)	42% to 49%	19-city survey
1990–1992	Highly Visible Enforcement (Vince and Larry Campaign)	53% to 62%	State Survey Aggregate
1992–1996	Modest increase in Primary Laws Modest STEP activity (Vince and Larry Campaign)	relatively flat Many changes in measurement	State Surveys NOPUS
1996–2000	Modest increase in Primary Laws National Enforcement Mobilizations	61% to 71%	NOPUS
2000–2003	Greatly enhanced Enforcement and Paid Media Efforts; Modest Increases in Primary Laws	71% to 79%	NOPUS

In Summary, progress has been made relative to increasing SBU from 11% in 1978 to 79% in 2003. Most of this increase has been associated with the enactment of SBU laws and with highly visible enforcement and media programs in support of these laws. Other programs, such as public information, education, and incentives appear to work best in an environment of enforced SBU laws. Table E-1 is an abbreviated list of the program efforts and phases that have been associated with the overall increase in SBU.

Post Script: The "Vince and Larry" (V&L) media campaign has been included in several of the above phases because, throughout much of the 1980s and 1990s, this public service campaign, managed by the Ad Council, was a central part NHTSA's occupant protection program. As such, it has been suggested at times that this popular campaign may have been a key factor in the increase in SBU from 1981 through 1995. However, a review of changes in SBU suggests that increases at the State level corresponded with changes in legislation and/or enforcement efforts and not necessarily with the presence of the V&L program (which was relatively continuous over time). This program is likely one of the very best examples of a popular and visible public service effort and, as such, it is possible that it contributed to the visibility and acceptability of the overall program. However, it is unclear whether this public service program, in the absence of more powerful activities, resulted in significant increases in SBU.

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Abbreviations used without definitions in TRB publications:

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