TCRP
REPORT 66

TRANSIT
COOPERATIVE
RESEARCH
PROGRAM

Sponsored by
the Federal
Transit Administration

Effective Practices to Reduce Bus Accidents

TRANSPORTATION RESEARCH BOARD

NATIONAL RESEARCH COUNCIL

TRANSIT COOPERATIVE RESEARCH PROGRAM

TCRP REPORT 66

Effective Practices to Reduce Bus Accidents

TECHNOLOGY & MANAGEMENT SYSTEMS, INC.
Burlington, MA

SUBJECT AREAS
Public Transit

Research Sponsored by the Federal Transit Administration in Cooperation with the Transit Development Corporation

TRANSPORTATION RESEARCH BOARD — NATIONAL RESEARCH COUNCIL

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TRANSIT COOPERATIVE RESEARCH PROGRAM

The nation's growth and the need to meet mobility, environmental, and energy objectives place demands on public transit systems. Current systems, some of which are old and in need of upgrading, must expand service area, increase service frequency, and improve efficiency to serve these demands. Research is necessary to solve operating problems, to adapt appropriate new technologies from other industries, and to introduce innovations into the transit industry. The Transit Cooperative Research Program (TCRP) serves as one of the principal means by which the transit industry can develop innovative near-term solutions to meet demands placed on it.

The need for TCRP was originally identified in *TRB Special Report 213—Research for Public Transit: New Directions*, published in 1987 and based on a study sponsored by the Urban Mass Transportation Administration—now the Federal Transit Administration (FTA). A report by the American Public Transportation Association (APTA), *Transportation 2000*, also recognized the need for local, problem-solving research. TCRP, modeled after the longstanding and successful National Cooperative Highway Research Program, undertakes research and other technical activities in response to the needs of transit service providers. The scope of TCRP includes a variety of transit research fields including planning, service configuration, equipment, facilities, operations, human resources, maintenance, policy, and administrative practices.

TCRP was established under FTA sponsorship in July 1992. Proposed by the U.S. Department of Transportation, TCRP was authorized as part of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). On May 13, 1992, a memorandum agreement outlining TCRP operating procedures was executed by the three cooperating organizations: FTA, the National Academies, acting through the Transportation Research Board (TRB); and the Transit Development Corporation, Inc. (TDC), a nonprofit educational and research organization established by APTA. TDC is responsible for forming the independent governing board, designated as the TCRP Oversight and Project Selection (TOPS) Committee.

Research problem statements for TCRP are solicited periodically but may be submitted to TRB by anyone at any time. It is the responsibility of the TOPS Committee to formulate the research program by identifying the highest priority projects. As part of the evaluation, the TOPS Committee defines funding levels and expected products.

Once selected, each project is assigned to an expert panel, appointed by the Transportation Research Board. The panels prepare project statements (requests for proposals), select contractors, and provide technical guidance and counsel throughout the life of the project. The process for developing research problem statements and selecting research agencies has been used by TRB in managing cooperative research programs since 1962. As in other TRB activities, TCRP project panels serve voluntarily without compensation.

Because research cannot have the desired impact if products fail to reach the intended audience, special emphasis is placed on disseminating TCRP results to the intended end users of the research: transit agencies, service providers, and suppliers. TRB provides a series of research reports, syntheses of transit practice, and other supporting material developed by TCRP research. APTA will arrange for workshops, training aids, field visits, and other activities to ensure that results are implemented by urban and rural transit industry practitioners.

The TCRP provides a forum where transit agencies can cooperatively address common operational problems. The TCRP results support and complement other ongoing transit research and training programs.

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The members of the technical advisory panel 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, the Transit Development Corporation, or the Federal Transit Administration of the U.S. Department of Transportation.

Each report is reviewed and accepted for publication by the technical panel according to procedures established and monitored by the Transportation Research Board Executive Committee and the Governing Board of the National Research Council.

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FOREWORD

By Staff
Transportation Research Board

TCRP Report 66, "Effective Practices to Reduce Bus Accidents," presents a directory of effective practices used to prevent bus accidents at small, medium, and large transit systems. Most of the information was obtained from 182 transit systems in the United States and in Canada and from statewide transit insurance pools in six states. The directory is designed to be used by transit management, operations, and safety personnel.

Accident prevention is a top priority of every bus operation. Generally, practices used to prevent accidents and promote safe driving fall into three categories: human resources, management, and operations.

Specific practices used to prevent accidents and promote safe driving vary widely among transit systems. There is no comprehensive inventory of such practices for operators to readily reference, nor have best practices been evaluated in a systematic manner.

Technology & Management Systems, Inc., in association with Boyd, Maier & Associates; Advanced Risk Management Techniques, Inc.; and Rolland W. King prepared this report for TCRP Project A-18. To achieve the project's objective of producing a directory of effective practices used to prevent bus accidents, the researchers identified and assessed accident prevention practices used by small, medium, and large transit systems, as well as by fleet operators outside the transit industry that have reduced bus accidents. Particular emphasis was placed on practices that could be directly linked to reduced accident rates.

Five transit bus agencies are identified as having exemplary safety performance on the basis of their collision injury rate and personal casualty injury rate over a 5-year period. The safety practice profile for each transit agency describes the management's approach to system safety, recruiting and hiring practices, training programs, programs for providing incentives for safe driving, procedures for monitoring driver performance, and other specialized practices.

The research team evaluated seven different accident prevention practices. Three of the practices seek to reduce accidents by improving bus operator performance. Four practices use technology to try to reduce bus accidents.

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The research reported herein was performed under TCRP Project A-18 by Technology & Management Systems, Inc. (TMS), of Burlington, Massachusetts.

H. Norman Ketola, Director of Technical Services for TMS, was the principal investigator and one of the authors of this report. The other author of this report was David Chia, Senior Transportation Consultant for TMS.

The work was done under the general supervision of Mr. Ketola. He and Mr. Chia conducted much of the research and analysis for this project. Other members of the research team included Ms. Annabelle Boyd and Ms. Patricia Maier of Boyd, Maier & Associates; Mr. Michael Kaddatz of Advanced Risk Management Techniques, Inc.; and Mr. Rolland W. King.

The research team also acknowledges the valuable contributions of transit systems throughout the United States and Canada and of the transit systems' staff, who provided time, data, and insight.

CHAPTER **1**

INTRODUCTION AND RESEARCH APPROACH

PROBLEM STATEMENT AND RESEARCH OBJECTIVE

Accident prevention is a priority of every bus operation. Generally, practices that are used to prevent accidents and promote safe driving fall into one of three categories.

- **Human resources**—including training, incentives to reward good performance, progressive discipline for adverse performance, operator selection, operator work rules and procedures, labor, safety awareness, and intervention for employees at risk.
- **Management**—including accident data tracking and analysis, accident investigation, public and passenger education, hazard identification and resolution, safety inspections, safety committees, and supervision.
- **Operations**—including bus stop location and design; snow and ice removal; traffic and parking enforcement; route selection and scheduling; use of undercover checkers on buses; and technology applications, such as cameras on buses, "black box" recorders, daytime running lights, and dual mirrors.

Specific practices that are used to prevent accidents and promote safe driving vary widely among transit systems, although most systems use all three types noted previously to some extent. There is no comprehensive inventory of such practices for operators to readily reference, nor have best practices been evaluated in a systematic manner.

The overall objective of the research was to develop a directory of effective practices used to prevent bus accidents. These practices were based on a thorough inventory and assessment of the safety practices used by small, medium, and large transit systems. Particular emphasis was placed on practices whose reduced accident rate was found to be directly attributable to a specific practice.

The products of this project are expected to be of principal value to transit managers, transit operators, transit safety personnel, and risk management staff of large, medium, and small transit agencies.

SCOPE OF STUDY

The phrase "accident prevention practices" covers a very wide range of activities at the typical transit system. For the purposes of conducting the necessary research and presenting the results in the form of a directory, all accident prevention practices were placed into one of seven major categories. The first three categories deal directly with the bus operator—the obvious focus of most bus accident prevention practices. The last four categories deal more indirectly with the bus operator. Descriptions of all categories follow.

- **Driver selection and hiring** refers to practices used to identify and attract potential candidates who have the proper skills and aptitude to become a safe and competent bus operator.
- **Driver training** refers to the initial training of new operators, regularly scheduled refresher training, and retraining triggered by one or more preventable accidents or observation of driving problems by supervisory personnel.
- **Safe driver incentive practices** refers to practices intended to reward bus operators for safe driving (i.e., for having no preventable accidents within a specific time period).
- **Customer safety practices** refers to practices that help a passenger avoid personal injury accidents while boarding, riding, or exiting a bus. Many of these practices target school children (particularly as the children exit the bus and leave the bus stop area) and passengers with disabilities.
- **Management practices** refers to activities that ensure that management is fully aware of bus accident trends and that identify specific problems with individual operators or types of buses. Examples include safety audits, ride checks, computerized accident or incident databases, safety committees for accident review, and practices for "accident repeater" drivers.
- **Bus technology safety improvements** refers to practices that enhance passenger safety and reduce collision accidents by increasing the visibility of the bus for pedestrians and for the drivers of other vehicles. Examples include low-floor buses, improved doors and door controls, improved driver vision through mirrors and lighting, high-visibility brake lights and warning signs, and daytime running lights.
- **Operating environment practices** refers to practices that help create a safer operating environment for buses,

such as making safety an integral part of new bus route planning, designing safer bus stop zones and placements, and providing pullouts or bus bays to remove the bus from a high-speed or congested travel lane.

RESEARCH APPROACH

The research activities on this project were divided into two phases:

- Phase I: Collection of Information on Accident Prevention Practices and
- Phase II: Evaluation of Selected Accident Prevention Practices and Preparation of Safety Practice Profiles.

Phase I

The major objectives of Phase I were to conduct a thorough inventory and assessment of accident prevention practices used by small, medium, and large transit agencies and to use that information to produce a directory of effective bus accident prevention practices. Three tasks were completed to achieve these objectives.

The first task was a literature search and review, which involved an on-line search of government, university, research center, and private holdings to identify bus accident prevention practices and evaluations. The review also included the collection of information from individuals with expertise in the area of bus safety.

The second task involved collecting data regarding transit systems' use of different accident prevention practices to find out which practices transit systems considered "highly effective." These data were obtained directly from small, medium, and large transit systems nationwide using a specially designed check-off form—the "Request for Information on Bus Accident Prevention Practices" form—that was mailed to 433 transit systems in the United States and to five transit systems in Canada. Information about bus accident prevention practices was also obtained from telephone interviews with six statewide transit insurance pools representing more than 100 separate transit systems.

The third task involved follow-up telephone interviews with selected transit systems to collect more detailed information about specific practices that the transit system representatives had rated as being "highly effective." The transit systems were selected for follow-up interviews on the basis of their record of exemplary safety performance. The objective of each interview was to obtain a description of the practice, determine whether the practice was obtained from an outside source, determine the length of time the practice had been in place, and learn the reason for believing that the practice was highly effective. In all applicable cases, the interviewer would request information on any quantitative evaluation of effectiveness, as well as request recent safety data submitted to the Federal Transit Administration (FTA) and any summary accident statistics developed for internal use by the agency.

The information collected in the third task was synthesized into a directory of effective bus accident prevention practices, which was presented in the Phase I interim report.

The Phase I interim report also contains detailed findings from the literature search and review, from the collection of data from transit systems nationwide, and from the collection of information from six statewide transit insurance pools.

The key findings from Phase I are essential to a comprehensive understanding of bus accident prevention. These findings form the basis of Phase II research and are presented in following appendixes.

- **Appendix A: Literature Search** contains a review of more than 100 publications and articles dealing with bus safety, accident prevention, and accident data and analysis, including highlights of documents and reports that were directly relevant to the research
- **Appendix B: Accident Prevention Practices Among Transit Systems** contains key results from 182 transit systems (small, medium, and large) describing their use of various accident prevention practices and ranking of effectiveness (highly effective, moderately effective, not effective, or don't know).
- **Appendix C: Accident Prevention Practices Among Transit Insurance Pools** contains key results from statewide transit insurance pools (also known as risk retention pools) in California, Michigan, Ohio, Virginia, Washington, and Wisconsin, including accident prevention practices used by the pools, their methods for measuring effectiveness and accountability, and some specific examples of their safety and loss prevention activities.

One of the major findings from Phase I was that transit systems lacked quantitative evaluations of the practices that they had rated "highly effective." In hindsight, this finding is not surprising, since transit personnel do not normally have the time, resources, and mandate to conduct the carefully controlled studies necessary to evaluate and document the effectiveness of a particular practice.

One outcome of this finding was a concern on the part of the project panel regarding the feasibility of conducting the in-depth evaluations planned for Phase II. The research team had to prepare a revised work plan for Phase II that would present a detailed plan for conducting the in-depth evaluations, including the basis for the selection of specific accident prevention practices and the actual transit system sites selected.

Phase II

The major objectives of Phase II were to conduct in-depth evaluations, as specified in the approved work plan, and to develop a more streamlined and informative directory of

effective accident prevention practices. The latter task was accomplished by removing practices that are well known and reasonably standard throughout the transit industry and adding the information developed during Phase II, particularly the evaluation results.

One of the major work activities in Phase II was the preparation of safety practice profiles for transit systems that have demonstrated exemplary safety performance over a number of years. The concept of the safety practice profile was prompted by the project panel's stated interest in presenting the mix of practices used by transit systems with an exemplary safety record. While the major emphasis of Phase II was the in-depth evaluation of specific practices and safety technologies, it was recognized that a *good safety record (i.e., a low rate of accidents) is the result of a whole range of practices*.

The proposed safety practice profiles were incorporated into the Phase II work plan to introduce the reader to the entire spectrum of accident prevention practices. Five transit agencies were selected for profiling on the basis of their exemplary safety record and their size (the research team wanted to provide a mix of small, medium, and large bus systems). Each transit agency is profiled separately using standard categories such as "management approach to system safety," "finding and hiring bus operators," and "training and retraining bus operators." This presentation allows readers to more easily find a specific area of interest and to more easily assess the different approaches and strategies used by small, medium, and large transit systems.

The rest of this report presents the research results, as follows:

- Chapter 2 provides the safety practice profiles of five exemplary transit systems,
- Chapter 3 provides the directory of effective practices used to prevent bus accidents,
- Appendix A presents the results of the literature search,
- Appendix B presents data on the use and effectiveness of various accident prevention practices among transit systems,
- Appendix C presents data on the use and effectiveness of various accident prevention practices among transit insurance pools, and
- Appendix D defines the acronyms and abbreviations used in this report.

CHAPTER **2**

SAFETY PRACTICE PROFILES

This chapter describes all safety and accident prevention practices used by five transit systems that have demonstrated exemplary safety performance over a period of 5 years (1992–1996). The fundamental purpose of the research presented in this report has been to identify and evaluate selected accident prevention practices; however, an exemplary safety record is the cumulative result of the overall safety program at each of these agencies—the collective effect of management approach and safety philosophy, accident prevention policies and practices, and appropriate use of hardware and technology.

Section 2.1 describes the process used to identify transit agencies with exemplary safety performance. Sections 2.2–2.6 present the safety practice profiles for five exemplary transit agencies in order of transit system size (i.e., the maximum number of buses operated in revenue service), ranging from the smallest to the largest, as shown in Table 1.

EXEMPLARY SAFETY PERFORMANCE AMONG BUS TRANSIT SYSTEMS

The criteria used for measuring the safety performance of a bus transit system for the purposes of this chapter include

- Collision injury rate (i.e., injuries per million vehicle miles) and
- Personal casualty injury rate (i.e., injuries per million passenger trips).

The source of the data used to measure safety performance is FTA's National Transit Database (NTD). Individual transit systems report safety and security data, along with financial and operational data, to FTA on an annual basis. The latest published data includes safety statistics from 326 transit agencies that directly operated transit buses.

The NTD safety and security data are published in a 1997 report prepared for the Federal Transit Administration by the Volpe National Transportation Systems Center. The report is titled, "Safety Management Information Statistics (SAMIS) Annual Report." Transit bus safety data are organized into three transit agency categories: large motor bus (LMB) for agencies operating more than 500 buses, medium motor bus (MMB) for agencies operating 100–500 buses, and small motor bus (SMB) for agencies operating fewer than 100 buses. Nineteen LMB, 68 MMB, and 239 SMB transit agencies reported safety data in 1997.

The term "incident," as defined in the NTD data collection forms and the SAMIS report, includes "collisions, personal casualties, derailments at the left roadway, fires, and property damage greater than $1,000 associated with transit agency revenue vehicles and all transit facilities." Incidents involving buses going off road and fires on buses are a minute fraction (less than 1 percent) of all bus incidents; therefore, only collision and personal casualty incidents were used in determining relative safety performance. "Personal casualty" includes all incidents in which a person is injured while on the bus (not including collision, bus left roadway, or fire incidents), while getting on or off the bus using a transit facility (e.g., bus stop or terminal), or while using a parking facility.

There are two important limitations in the NTD safety data. First, the NTD combines both preventable and nonpreventable accidents into the single category of safety incidents. The second limitation involves the reporting threshold used by FTA for collision incidents that do not result in any injuries or fatalities. Incidents involving damage to transit vehicles or transit property are only reported if the dollar amount to repair or replace exceeds $1,000. Therefore, the NTD data screen out minor collision incidents.

A careful review of the NTD data indicates that many transit agencies have problems in consistent reporting of collision incidents. The research team determined that a transit agency had reporting problems if the transit agency had a large fluctuation in the yearly totals of collision incident, an unusually small ratio of collision injuries to collision incidents, or both.

The majority (85–90 percent) of all reported collision incidents involve another vehicle. Given this fact, and given that one or more persons will probably be injured in a collision that causes more than $1,000 in damage to a transit bus, the overall rate of collision injuries to collision incidents for a bus system should be close to 1.0.

Table 2 presents summary NTD data on transit bus collision incidents and injuries, as well as personal casualty incidents and injuries for the 1994, 1995, 1996, and 1997 reporting years. The rates of collision injuries per incident data for all small, medium, and large bus systems fall into a narrow range from approximately 0.75 to 1.00. This range is consistent with the research team's expectations.

TABLE 1 Transit agencies selected for safety practice profiles

City	Transit Agency	Maximum Number of Buses Operated in Revenue Service
Duluth	Duluth Transit Authority	71
Phoenix	Phoenix Transit System	287
Atlanta	Metropolitan Atlanta Rapid Transit Authority (MARTA)	575
Denver	Regional Transit District (RTD)	860
Seattle	King County Metro Transit (Metro Transit)	1,092

A number of transit systems report a very low ratio of injuries per collision incident (i.e., 0.2–0.4). The most likely explanation of such a low ratio is that these transit agencies report minor collision incidents (i.e., collision incidents causing less than $1,000 in transit property damage) to FTA.

To avoid the problem of inconsistent reporting of collision incidents, the research team decided that the measurement of safety performance among transit agencies should be based on the rate of collision injuries. The rate of vehicle miles traveled was used as the rate base for evaluation because it directly measures the exposure risk of a transit bus colliding with another vehicle, object, or person.

There is no consistency problem in the reporting of personal casualty incidents and the reporting of injuries since, by definition, any personal casualty incident must be associated with at least one injury. For the most part, personal casualty incidents involve slips, trips, and falls by an individual. Occasionally, more than one individual may fall because of an abrupt motion (e.g., acceleration, deceleration, or turning). The data in Table 2 demonstrate a one-injury-to-one-incident relationship, since, independent of system size, the ratio of injuries to incidents lies in the very narrow range of 1.06–1.18.

For personal casualty incidents and injuries, the rate base used for evaluation and comparison is the number of passenger trips. The number of passenger boardings and alightings (i.e., unlinked passenger trips) directly measures exposure to the risk of slipping, tripping, and falling accidents involving a transit bus.

Table 3 presents safety data for the six large transit bus systems (out of 19 agencies reporting in this category) that had the lowest average collision injury rates for the 5-year period from 1992 to 1996. (SAMIS 1997 data for *individual* bus systems were not yet available.) Table 3 also presents data on personal casualty incidents and injuries for the six agencies.

Exemplary safety performance, as presented in Table 3, has been determined by collision injury rate rather than personal casualty injury rate for two reasons. The first reason is that injuries resulting from transit bus collisions where significant (i.e., more than $1,000) damage is done to the bus will be more serious, on average, than injuries resulting from slips, trips, and falls. The second reason is that erroneous personal casualty incidents may be included in the totals reported because a percentage of passenger-reported personal casualty incidents and injuries may be fraudulent. Passengers report these fraudulent claims in the hopes that the transit agency will make a quick and modest cash settlement. There is no way to be certain how many personal casualty incidents or injuries fall into this category.

From the list of transit bus systems in Table 3, three out of the top four were selected for the safety practice profiles. Portland Tri-Met had the second lowest collision injury rate, but its personal casualty incident rate was substantially higher than the other large bus systems selected, including the Regional Transportation District (RTD) in Denver, the King County Metro Transit (Metro Transit) in Seattle, and the Metropolitan Atlanta Rapid Transit Authority (MARTA) in Georgia.

TABLE 2 Four-year summary of collision and personal casualty incidents or injuries

Transit Bus Collisions	Small Bus Systems				Medium Bus Systems				Large Bus Systems			
	1994	1995	1996	1997	1994	1995	1996	1997	1994	1995	1996	1997
• Incidents	1,851	1,832	1,848	1,376	8,324	6,870	7,366	5,924	17,450	15,039	14,092	15,619
• Injuries	1,464	1,868	1,558	1,270	4,990	5,191	5,421	5,182	13,085	13,760	14,095	13,582
• Injuries per Incident	0.791	1.020	0.843	0.922	0.599	0.756	0.736	0.875	0.750	0.915	1.000	0.870
Personal Casualties on Transit Buses												
• Incidents	2,412	2,199	2,045	1,865	6,312	6,084	5,909	5,363	12,348	10,372	8,820	10,057
• Injuries	2,553	2,376	2,174	1,960	6,779	6,545	6,371	5,665	13,121	11,543	10,386	11,367
• Injuries per Incident	1.058	1.080	1.063	1.051	1.074	1.076	1.078	1.056	1.062	1.113	1.178	1.130

TABLE 3 Exemplary safety performance: Large bus systems

City System Name	Year	Collision Incidents	Collision Injuries	Personal Casualty Incidents	Personal Casualty Injuries	Collision Injury Rate (MVM)	Personal Casualty Injury Rate (MPT)
Denver RTD	92	173	48	130	129	2.41	2.44
	93	108	67	149	147	3.29	2.74
	94	163	70	135	135	3.52	2.52
	95	116	75	154	154	3.45	2.90
	96	109	70	161	161	3.04	2.95
Average						**3.14**	**2.71**
Portland Tri-Met	92	459	29	56	56	1.32	1.05
	93	102	134	269	269	5.95	5.13
	94	116	75	525	524	3.17	9.58
	95	175	115	822	822	5.54	14.64
	96	106	75	376	375	3.52	6.18
Average						**3.90**	**7.32**
Seattle Metro	92	160	131	281	282	3.47	3.49
	93	170	155	276	289	5.32	3.60
	94	190	139	259	259	4.74	3.29
	95	239	228	484	495	7.36	6.19
	96	245	140	514	536	4.32	6.17
Average						**5.04**	**4.55**
Atlanta MARTA	92	193	68	47	47	2.68	0.61
	93	244	146	70	65	5.81	0.89
	94	222	84	68	65	3.31	0.89
	95	289	118	64	61	4.65	0.83
	96	167	311	31	29	11.88	0.40
Average						**5.67**	**0.72**
Minneapolis MCTO	92	141	180	340	385	7.91	5.81
	93	152	277	426	426	11.48	6.40
	94	132	296	424	424	12.11	6.48
	95	97	251	396	426	10.99	6.98
	96	150	406	486	521	17.45	8.42
Average						**11.99**	**6.82**
San Francisco Muni	92	805	212	531	558	10.56	3.00
	93	856	258	569	596	12.83	3.29
	94	1818	220	508	548	11.12	3.17
	95	240	334	539	559	17.23	3.29
	96	212	190	538	547	9.92	3.26
Average						**12.33**	**3.20**

Table 4 presents the 14 medium-sized bus systems that have the lowest collision injury rates of the 68 transit agencies that reported in this category. Technically, the top-ranked system, the Duluth Transit Authority (DTA), is not a medium-sized bus system; however, DTA was included because it has an exemplary record on both collision injury and personal casualty injury rates and because it operates 71 buses at maximum service, which is close to the threshold of 100 for medium systems.

A comparison of Tables 3 and 4 illustrates that collision injury rates are lower for the medium systems than for large systems, as one would expect, considering that large systems generally operate in major metropolitan areas with higher traffic densities.

The two transit agencies selected for safety practice profiles from Table 4 include DTA and Phoenix Transit System (PTS). At the time of the selection in early 1998, only data from 1992 to 1995 were available. PTS was selected because it had the fourth lowest average collision injury rate while operating a relatively large number of buses (287 in maximum service).

The following sections of this chapter present safety practice profiles for each of the five exemplary systems, starting with DTA and ending with Metro Transit. The safety practices information is presented in a uniform format for each transit system.

DULUTH TRANSIT AUTHORITY

DTA operates in the Duluth, Minnesota, and Superior, Wisconsin, metropolitan area. DTA operates 71 transit buses during maximum revenue service, accumulating approximately two million vehicle miles and serving approximately three million passengers each year.

The topography in the Duluth area makes the operating environment particularly challenging for DTA bus operators. Bus

TABLE 4 Exemplary safety performance: Medium bus systems

City System Name	Year	Collision Incidents	Collision Injuries	Personal Casualty Incidents	Personal Casualty Injuries	Collision Injury Rate (MVM)	Personal Casualty Injury Rate
Duluth DTA	92	3	0	4	4	0.00	1.17
	93	10	0	6	6	0.00	1.75
	94	163	0	6	6	0.00	1.87
	95	116	3	4	4	1.55	1.30
	96	109	0	3	2	0.00	0.62
Average						**0.31**	**1.34**
Central Contra Costa County County Connection	92	4	2	80	80	0.45	18.89
	93	7	9	25	26	1.95	6.38
	94	5	0	18	18	0.00	3.94
	95	4	4	26	26	0.94	6.52
	96	5	2	4	4	0.50	0.80
Average						**0.77**	**7.31**
San Diego NCTD	92	13	15	118	117	1.63	11.36
	93	9	9	73	73	0.99	7.05
	94	15	16	67	69	1.76	6.54
	95	10	11	50	50	1.19	4.64
	96	7	8	63	63	0.87	5.82
Average						**1.29**	**7.08**
Albuquerque SunTran	92	69	6	20	20	1.36	3.17
	93	18	7	42	42	1.58	6.54
	94	159	8	68	65	3.31	0.89
	95	9	3	13	14	0.73	2.18
	96	12	9	24	24	2.12	3.63
Average						**1.53**	**3.88**
Salt Lake City UTA	92	45	42	65	63	2.43	2.33
	93	24	28	37	34	1.60	1.37
	94	10	8	57	57	0.45	2.34
	95	30	36	121	120	2.00	4.90
	96	46	37	48	49	1.95	2.06
Average						**1.69**	**2.60**
Nashville MTA	92	117	7	20	28	1.77	3.43
	93	5	3	12	12	0.77	1.89
	94	10	8	13	13	1.98	1.87
	95	16	12	5	5	2.93	0.76
	96	8	6	6	6	1.46	0.77
Average						**1.78**	**1.74**
Memphis MATA	92	28	46	36	41	6.19	3.11
	93	16	11	7	7	1.55	0.55
	94	14	10	6	6	1.40	0.50
	95	12	7	6	7	0.98	0.50
	96	14	9	5	5	1.23	0.44
Average						**2.27**	**1.02**

(*continued on next page*)

TABLE 4 (Continued)

City System Name	Year	Collision Incidents	Collision Injuries	Personal Casualty Incidents	Personal Casualty Injuries	Collision Injury Rate (MVM)	Personal Casualty Injury Rate
Omaha MAT	92	9	15	20	20	3.49	3.39
	93	9	9	14	14	2.11	2.70
	94	31	13	8	8	3.07	1.55
	95	36	4	6	6	0.95	1.21
	96	19	11	0	0	2.70	0.00
Average						**2.46**	**1.77**
Syracuse RTA-Centro	92	33	12	19	19	2.89	1.56
	93	33	11	27	30	2.74	2.62
	94	33	7	28	28	1.61	2.40
	95	28	11	21	21	2.55	1.69
	96	11	9	11	11	2.53	1.24
Average						**2.46**	**1.90**
Tucson Sun Tran	92	28	23	35	35	3.29	2.13
	93	38	13	7	7	1.76	0.39
	94	24	15	4	6	1.95	0.35
	95	46	29	12	12	3.94	0.76
	96	58	16	6	6	2.06	0.34
Average						**2.60**	**0.79**
Tacoma Pierce Transit	92	26	22	8	39	3.61	4.14
	93	9	1	2	40	0.17	4.21
	94	11	22	7	50	3.13	4.23
	95	16	22	3	37	2.66	3.23
	96	28	32	39	39	3.85	3.28
Average						**2.68**	**3.82**
El Paso Sun Metro	92	10	3	137	133	0.59	8.64
	93	35	17	91	91	3.14	6.04
	94	36	11	90	90	1.74	5.60
	95	38	40	96	96	5.96	6.17
	96	13	21	64	74	3.18	4.78
Average						**2.92**	**6.25**
Phoenix PTS	92	32	36	39	48	3.07	1.58
	93	42	11	54	66	0.98	2.19
	94	33	2	86	99	0.18	3.29
	95	22	10	81	122	0.88	3.83
	96	64	105	56	71	9.59	2.57
Average						**2.94**	**6.25**
Madison Metro	92	23	12	1	0	2.73	0.00
	93	23	10	8	8	2.27	0.84
	94	31	25	4	4	5.52	0.41
	95	22	4	0	0	0.87	0.00
	96	12	23	101	101	4.91	10.29
Average						**3.26**	**2.31**

routes that originate in the downtown area (which is 600 ft above sea level) have to climb about 600 ft in less than one mile to serve neighborhoods that are located along a ridge. This type of steep climb (and descent) for the DTA buses is similar to that encountered in San Francisco.

Because of Duluth's northern location and its proximity to Lake Superior, weather conditions are extreme. Summer temperatures average about 75 degrees, but can reach the mid-90s. Winter is cold and harsh. Average temperature highs from mid-December to the end of February are around 15°F. It is common to have 5–10 day cold snaps with temperature lows of −30 to −20°F and temperature highs in the single digits. Duluth saw record cold in January 1995, with an average high of 5°F and a low of −45°F.

Snow covers the ground from November to mid-April. Average seasonal snowfall is about 80 in. Annual snowfall is quite frequently above 100 in. In 1995, there was a record snowfall of 145 in. The winter of 1996 was the second snowiest, with 139 in. Duluth averages 20–25 snow events of 2 in. or more each year.

Management Approach to System Safety

DTA has a written safety practice that covers safety policies and procedures for DTA's transportation and maintenance departments, with special sections on accident and incident investigation and a student safety practice.

The purpose of the DTA safety practice is to provide the safest transit service and workplace possible, thus minimizing the costs of physical damage and personal injury accidents. The safety practice is broad, with all employees accountable for the safe performance of their jobs. The safety practice permeates each department, including the recruiting and training of new employees, maintenance, training and retraining of bus operators, building inspections, supervisory training, provision of safety information, accident investigation and cause analysis, community practices, and claims management.

The safety practice is administered by the Director of Safety, who reports to the Director of the DTA Operations Division. The General Manager determines the policies and scope of the safety department. Other department directors and supervisors are responsible for safety practices within their respective departments.

Finding and Hiring Bus Operators

Recruiting the proper individual to fill the position of bus operator is a prominent part of the DTA safety practice. Each prospective bus operator must file an application for employment, authorize a background check, and be interviewed by the Director of Operations. Each new bus operator must have a good driving record, pass an Interstate Commerce Commission (ICC) physical examination and a drug and alcohol test, and qualify for a commercial driver's license (CDL). Prior commercial driving experience is preferred, but not required.

Training and Retraining Bus Operators

People who are hired as new bus operators must successfully complete the DTA New Bus Operator Training Program. Four new bus operators are generally hired and trained at the same time. This program is 28 days long and includes the following.

- **The U.S. Department of Transportation's (U.S.DOT's) Bus Operator Training Program.** This course is taught in five 2-h classroom segments. The course covers basic and advanced bus maneuvers, defensive driving principles, and accident prevention.
- **Passenger relations and safety.** This course also consists of five 2-h classroom sessions and deals with customer relations and passenger safety.
- **Road training.** The road-training segment consists of 6 h of on-street bus driving each day. Road training begins on the first day of training and continues for 15 days. Trainees alternate driving the bus.
- **Basic first aid.** All new bus operators are required to pass the 8-h American Red Cross Multimedia First Aid course.
- **Fire safety.** A 1-h fire safety program is presented. This program includes fire prevention, recognition, safe evacuation of passengers, and other procedures.
- **Loss, liabilities, and accident reporting.** This 3-h segment is designed to provide the new bus operator with information regarding the costs of accidents, no-fault liabilities, litigation, and physical damage. Major emphasis is placed on reporting procedures and requirements.
- **Driving in hazardous conditions.** This 1-h segment covers driving when snow and icy street conditions exist.
- **Student rider safety.** This 2-h segment covers the DTA safety policies for transporting student riders safely, handling misconduct problems, and dealing effectively with the student rider.
- **Drugs and alcohol.** This 2-h program reviews the DTA drug and alcohol policies and the Drug Free Workplace Act and provides information about the effects of using drugs and alcohol.
- **Americans with Disabilities Act (ADA).** This 2-h program covers the ADA requirements for DTA's service to people with disabilities. Approximately 50 percent of this program is dedicated to operator sensitivity and the service needs of passengers with disabilities.

In addition to the aforementioned practices, the new bus operator receives training regarding DTA policies, including fare and transfer policies, pretrip inspections, routes and run cards, station procedures, general DTA policies, and an orientation in the maintenance department. After completing 20 days of training, each trainee receives an evaluation from the Safety Director and the Road Training Instructor. If the trainee demonstrates adequate skill in proper operation of the bus, she or he progresses to the in-service part of the training program, "Line Practice."

Line practice is actual in-service training. The new bus operator works with an experienced bus operator during regularly scheduled service. This segment lasts 7 days. At the conclusion of the line practice segment of training, a final ride check is conducted by the Director of Operations. Follow-up ride checks are made by each operator's supervisor during the next several months.

All DTA bus operators hired prior to 1984 have received 10 h of defensive driving and customer relations training. This course was a modified version of the U.S.DOT's Bus Operator Training Program and was presented in 1985. All bus operators attended a 4-h customer relations training program in 1984. Retraining was provided to all bus operators in 1991 and 1993.

The safety department also administers a retraining program for operators having problems with operating the bus and customer relations. Because these programs are tailored to help the operator correct a specific problem, they vary in length.

Bus operators who have been away from the job for an extended period because of illness, leave of absence, and so forth are given reorientation when they return to work. This practice is conducted by an operations supervisor.

Providing Incentives for Safe Driving

DTA presents safety awards to recognize bus operators and maintenance employees who work accident free. The awards

include safety pins and certificates, jackets, and a watch, depending on the number of years of accident-free driving.

DTA recognizes an employee each month as employee of the month. This employee is nominated by his or her peers for excellent job performance and accomplishments. The employee of the month receives a plaque, dinner for two, a special parking spot for the month, and a commendation from the General Manager. The employee of the month then becomes eligible to be selected as the employee of the year. The employee of the year receives a plaque, a $100 gift certificate, a preferential parking spot for the year, and other recognition.

DTA sponsors an annual bus roadeo. Roadeo contestants maneuver their buses through a difficult obstacle course. All contestants are judged according to specified criteria. Winners of the bus roadeo receive a plaque and prize money. All bus operators and maintenance employees are eligible to participate. The top two bus operators also qualify to participate in the Minnesota State Bus Roadeo.

DTA sponsors an annual safety banquet. The purpose of this banquet is to honor bus operators and maintenance employees who have worked accident free for the past year. During the banquet, the employees of the month are recognized and the employee of the year is announced.

Monitoring and Managing Bus Operator Safety Performance

Each operations supervisor is required to make safety ride checks with each of their employees twice a year. Each supervisor is assigned approximately 40 bus operators. During the ride check, the supervisor observes the operator's safety habits, appearance, customer relations, and general operation of the bus. At the conclusion of the ride check, the supervisor reviews the results with the operator and discusses any recommendations that may be necessary. The ride checks help improve the rapport between supervisors and bus operators. The Safety Director also makes ride checks when an operations supervisor makes a recommendation.

All bus operators and maintenance personnel are required to have a CDL in the class required by the state issuing the license. DTA checks all driving records annually. DTA complies with the Federal Highway Administration's Commercial Driver Licensing Standards.

Operations supervisors provide on-street supervision of the DTA transit operations. The supervisors are responsible for overseeing DTA operations and for ensuring that all safety-related operating policies are adhered to. Supervisors routinely take corrective action to solve observed problems. In addition to supervising the bus operators, the supervisor also takes care of other safety-related problems (e.g., alerting operators about poor weather and road conditions, inspecting detours, and reporting traffic problems).

Employees are required to report all accidents at the time of the accident's occurrence. Employees are required to report collision accidents, passenger accidents, witnesses, vandalism, discovered vehicle damage, student misconduct, work-related injury, and passenger problems. All reports are reviewed and investigated by supervisory personnel.

After reviewing the investigative material, a three-member, accident-judging committee judges all collision and passenger accidents as preventable or nonpreventable. This committee is comprised of the Safety Director, an operations supervisor, and a bus operator. Determinations are based on written standards for defensive driving. Employees are given written notification of the determination.

Employees may also appeal determinations to a seven-member, accident-determination appeals committee. The committee comprises two operations supervisors, two bus operators, and three police officers. This committee meets when necessary to determine whether an accident was preventable. The decision of this committee is final.

Specialized Safety Practices

A bus damage reduction program was initiated in September 1988. The purpose of this program is to eliminate all blind (i.e., unreported) accidents and to promote safe driving. Each bus is repaired and made damage free. When a bus is damage free, a blue sticker is placed in the front windshield. When a bus operator is assigned a bus with a blue sticker, they are required to report any discovered damage prior to leaving the garage. When the bus is returned to the garage, maintenance personnel inspect each bus and report any damage.

Student riders constitute a major portion of DTA's patrons. DTA provides nearly 4,000 student trips per day. DTA takes an active role in student safety. The student safety program is entitled, "Operation Bus Ride," and includes the following.

- **Bus puppet show.** This puppet show is performed for all third graders and emphasizes bus safety.
- **Safety posters.** These posters are provided to all classrooms. There is a series of nine posters.
- **Driver training.** DTA drivers receive training in how to handle problems with student riders. Safety meetings are held, and written material is furnished to all bus operators regarding student safety.
- **Supervision.** Operations supervisors devote a substantial part of their time to student safety.

PHOENIX TRANSIT SYSTEM

PTS provides fixed-route bus service in Phoenix—the fastest-growing city in the United States during the 1990s—and the surrounding metropolitan area. PTS operates 282 buses during peak service. The total fleet traveled over 9.6 million revenue miles and provided 29.3 million passenger trips in fiscal year 1998.

The climate and topography are generally favorable for PTS bus operations. The area is dry (it has an annual average rainfall of 7 in.) and hot (it has an annual average of 164 days with temperatures 90°F or above), and the service area is nearly flat. And while the city is growing, local traffic is less congested, relative to other large cities.

Management Approach to System Safety

Senior management at PTS has displayed a strong commitment to safety through their support and actions. Management's concern for the safety of passengers and employees takes precedence over all other activities and functions at PTS.

The safety department of PTS has developed and maintained a *Preventive Safety Program and Practices Manual*. The manual, originally prepared in 1986, has an opening statement by the General Manager stating his full commitment to the program. The manual has been reviewed and approved by all members of the PTS senior staff. The manual, which is updated on a regular basis, is currently undergoing a change in format and a streamlining of the contents to make it more accessible.

Finding and Hiring Bus Operators

PTS is fully aware of the importance of hiring competent and professional individuals for the position of bus operator. This task is particularly challenging given the current state of the economy and the low unemployment rate in the Phoenix area. PTS has found remaining competitive in the present job market increasingly difficult. Under current conditions, PTS only hires full-time bus operators, because hiring and retaining part-time operators is virtually impossible. Following is a simplified breakdown of the steps in the existing hiring procedure.

1. Recruitment is done through a variety of media, including newspapers, magazines, and television advertising.
2. Applications are filled out, and the personnel department reviews them.
3. Applicants are called in for the U.S. DOT Buss Operator Selection Survey (BOSS) test, and the tests are then sent out for scoring.
4. Personal interviews are set up and performed by members of the operations and training departments.
5. All information packets are updated and put together for non-CDL applicants and handed out at the time of the interview.
6. The personnel department sets up pre-employment physical examinations, including drug screening and a musculoskeletal assessment.
7. Verification-of-employment forms are mailed to the applicants' former employers.
8. Background checks are performed on all individuals considered for hire.
9. When the information has been received on the physical exam, drug screen, verification of employment, and background check, PTS calls the applicants with an offer of employment.
10. Successful candidates are informed of the dates for their upcoming operator training class.
11. The personnel department conducts follow-ups with all candidates throughout the training phase until the candidates' start date as bus operators.

Training and Retraining Bus Operators

PTS believes that training, along with the hiring process, is most critical to success in the area of safety. Once PTS has hired a quality employee, PTS fully trains that individual in all aspects of the new position.

The PTS Bus Operator Training Class is a 6-week (i.e., 33-day) training program. PTS has taken the best safety and training courses of the National Safety Council (NSC), Transportation Safety Institute (TSI), and other agencies and combined them into a very site-specific course. The training department has fine-tuned this course through many years of experimentation to determine the most effective method for use.

The training consists of both classroom and behind-the-wheel sessions, in a unique combination that keeps the interest high for trainees. Topics are varied and mixed so that the trainee is not subjected to the traditional training that usually predominates in most classroom instruction. An example of the diversity of techniques used by PTS is shown in Figure 1, which presents the training schedule for Days 2 and 3, including activities related to defensive driving. Note that PTS makes extensive use of specialized videos as part of their training.

Providing Incentives for Safe Driving

PTS bus operators take great pride in the fact that their operation has been recognized as one of the safest bus fleets in North America. PTS has a safe driver award program that recognizes the safety performance of PTS bus operators. The program follows NSC guidelines and uses award pins and wallet cards from NSC. In addition, PTS provides award recipients with a personalized patch for their uniform and a wall certificate. Award recipients also receive pencils, pens, and a gift certificate from a local merchant. PTS recently held its 15th annual bus roadeo, an event that includes a cash award, plus an all-expense paid trip to the American Public Transportation Association (APTA) International Bus Roadeo each year.

Monitoring and Managing Bus Operator Safety Performance

The safety and training departments work closely together to ensure that once the bus operators have gone through their

PTS Training Schedule

Thursday, July 29, 1999 (Day 2), South Facility
7:00 am–5:00 pm (30 min lunch)

7:00 am–11:00 am	Defensive Driving Education - Chapter 10

Defensive driving will be split in two days. It will include a slide presentation, videos, and a short trip on a bus to talk about bus maneuvering. This trip will include brief stops at transit centers.

Videos:	Surveying the Road Intersections Lane Position RTS/Grumman Blind Spots
11:00 am–11:30 am	Route & Driving Logs/Group assignments/Signs
11:30 am–12:00 am	LUNCH
12:00 pm–3:15 pm	Training Field/practice elementary driving skills (Training Field Only)

Activities to be completed:

* Instructor to explain the proper seat and mirror adjustments, then properly adjust them.
* Proceed to training field, instructor will concentrate on the items on this page.
* Instructor will drive to Training Field & demonstrate “textbook” right (square & belly-out) & left turns.
* Each of these topics will be reviewed on a daily basis. Every time you operate a bus, these topics will be discussed and/or reviewed.

_____ Proper headsign reading (DRIVER TRAINING/NOT IN SERVICE)

_____ Square right turns	_____ Proper foot position on pedals
_____ Square left turns	_____ Safety zone/Blind spots
_____ Defensive driving techniques	_____ Proper RR crossing procedure
_____ Proper following distance	_____ Belly-out right turns
_____ Proper hand position on wheel	_____ Signaling
_____ Proper scanning of intersections	_____ Proper stopping distance
_____ Intersection safety	_____ Proper execution of service stops

3:15 pm	RETURN BUSES TO DISPATCH
3:15 pm–5:00 pm	Continue Defensive Driving

9:30

For Tomorrow: *Read Chapter 2, Chapter 3, & Chapter 10. Review Study Guides on routes, schedule reading, & defensive driving*

Figure 1. Phoenix Transit System’s daily training schedule for Days 2 and 3.

PTS Training Schedule

Friday, July 30, 1999 (Day 3), South Facility
7:00 am–5:00 pm (30 min lunch)

7:00 am–12:15 pm	Continue Defensive Driving Education-Chapter 10
	Videos: Speeding Fire Truck Experience Arctic Blind Spots News Count Defensive Driving Keys
	Defensive Driving Road Trip We will have lunch on the road trip
12:15 pm–1:45 pm	Route Information-Chapter 2 Video: Valley Bus System
1:45 pm–2:00 pm	Break
2:00 pm–4:00 pm	Reading Schedules-Chapter 3 Video: How to Read the Bus Book
4:00 pm–5:00 pm	Route Cards

9:30

For Monday:	*Routes #8 & #28* *Review Chapter 10* *We will be driving from now on. Please wear appropriate shoes.*

Figure 1. (*Continued*)

initial training, they are observed and evaluated on a regular basis. This observation and evaluation is done through line instructors, road supervisors, and an independent agency that performs ride checks.

PTS also provides additional training through a transit refresher education course, which is taught on a regular basis to evaluate an operator's performance, to further enhance her or his driving skills, and to provide information on changes to operational procedures and practices.

In the event of an accident, PTS has an accident review committee that ultimately determines whether the accident was preventable. An operator charged with a preventable accident will receive at least 1 day of refresher training. There may also be disciplinary days off in addition to the training, if warranted, as defined by the PTS union contract.

Bus Technology Safety Improvements

PTS has always been known for, and prided itself on, its innovative technology and practices. PTS was the first transit system in the United States to fully equip its bus fleet with bike racks. PTS was also a leader in the use of deceleration lights, having fully equipped its fleet 15 years ago. PTS very seldom leaves a bus as it came delivered from the manufacturer, but constantly retrofits equipment to benefit both operators and customers. Many of these retrofits have been included in future bus procurements or have even been adopted as original equipment by the manufacturers.

Some of these technology improvements include

- Numerous changes to the driver workstation;
- Daytime running lights;
- Door changes;
- Ramps on low-floor buses;
- Additional mirrors or changes to the location of mirrors;
- Surveillance cameras;
- Additional passenger hand grips;
- Mobility aid securement systems;
- Additional decals and signage; and
- Improved, brighter LED lighting all around the bus.

Safety Improvements in the Operating Environment

The surroundings in which PTS operates constantly change; therefore, the operating environment is constantly being reviewed by the city of Phoenix, various departments of PTS, road supervisors, line instructors, and bus operators. All these individuals provide valuable input, which ultimately results in a safer transit agency.

Routes are constantly monitored and assessed, and adjustments are made to provide a safer route or better running time. Initial route selection is checked for poor traffic conditions, unfavorable obstacles or turns, and other problems that would be detrimental to the safety of the passengers.

The city of Phoenix has standard guidelines and designs for the placement of bus stops, shelters, turnouts, and pullouts. These guidelines are subject to change depending on special circumstances that might exist at any given location. All stops and shelters are cleaned and maintained on a regular basis to ensure cleanliness and security for the passengers.

Specialized Safety Practices

PTS also has several special programs that promote safety and, at the same time, educate potential riders on using the bus. PTS has outreach coordinators who go to schools, businesses, senior centers, and various disabled communities to instruct potential riders on using the bus. Many of these visits include training on how to board and alight safely, as well as the proper conduct while on the bus. The disability training is directed at people who are blind or hearing-impaired, people who may be using their service animals, and people who require instruction on mobility-aid use.

METROPOLITAN ATLANTA RAPID TRANSIT AUTHORITY

MARTA operates approximately 575 buses during maximum revenue service hours. These buses operate on 150 routes with a total of 1,500 route miles.

MARTA buses operate under conditions that can be characterized as moderate in topography and climate. There are relatively few gradients along the routes, and the probability of encountering ice or snow during the winter is extremely low.

Management Approach to System Safety

MARTA has a system safety program plan that covers both its rail and its bus operations. MARTA plans to update and publish a revised version of the plan.

MARTA's Office of Safety has the primary responsibility for compiling bus accident statistics and conducting assessments of accident trends and other issues affecting bus safety. The Bus Safety Officer prepares a monthly report that summarizes the number of accidents and the rate of accidents (per 100,000 miles) for each of the three operating divisions.

Finding and Hiring Bus Operators

MARTA's current practice is to hire all new operators on a part-time basis. These part-time operators generally work a maximum of 25 hours per week. It typically takes 12–16 months before the part-time operator is moved to full-time work.

MARTA's major sources for identifying and recruiting candidates are newspaper and radio ads and employment offices operated by the State Department of Labor. MARTA has experienced increasing difficulty trying to find good bus operator candidates under current low unemployment conditions.

The basic requirements for becoming a MARTA bus operator include a high school diploma or equivalent and 2 years of experience operating commercial vehicles, preferably including 6 months of experience driving in heavy traffic. The special classification requirements include the following.

- **Age.** At least 25 years old.
- **Height.** 5 ft 2 in. minimum, 6 ft 4 in. maximum.
- **Physical condition.** Must meet MARTA standards, including no addiction to alcohol or drugs. Candidates must pass a MARTA-paid physical examination.
- **Tests.** Must pass a set of test questions.
- **License.** Must hold a valid CDL and be able to obtain a Bus Operator Police Permit from the Atlanta Police Department.
- **Employment record.** Must have a favorable job history and satisfactory references.
- **Punctuality.** Must be able to arrive at work on time to permit maintenance of schedules.

Potential candidates who meet these special minimum classification requirements will be notified of a testing date. MARTA uses the "Seattle Metro Video Test" as the basic screening tool. Applicants scoring 160 or above on this test are set up for an interview with a panel. The interview panel usually consists of superintendents from the bus garages, supervisors, and a representative from the training department.

Individuals who pass the interviews are then scheduled for the pre-employment physical exam, including drug testing. Upon successful completion of the exam and testing, the applicant receives an offer for employment as a part-time operator at a maximum of 25 h per week.

Training and Retraining Bus Operators

MARTA's Bus Operator Development Program is conducted over a 33-day period. The actual training takes place over 29 days (there are 4 days off), using a combination of classroom training (90 h), on-the-job driver training with an

instructor (32 h), revenue service with a line instructor (80 h), and tripper assignments with a line instructor (30 h).

MARTA conducts refresher training (or retraining) for operators who have had either one or two preventable accidents within a 24-month period. Operators with three preventable accidents within 24 months are subject to discharge.

Retraining associated with the first preventable accident in a 24-month period includes approximately 30 min in a review of the incident with the operator; 2 h in the classroom for defensive driving review; and 2 h of on-road defensive driving training with a visit to the accident scene during this driving period. The total retraining time can be as long as 8 h, as deemed necessary by the Safety Training Center.

Retraining after the second preventable accident is similar to retraining after the first preventable accident, except that the former also includes as much as 3 h in a CDL skills course that teaches defensive driving techniques. The operator is also required to take and pass certain portions of the Georgia State CDL Skills Test.

Providing Incentives for Safe Driving

MARTA has a "safe driver patch" award program for rewarding accident-free driving. The eligibility criteria for the patch program are also used for awarding safe driver luncheon certificates. The minimum criterion for the first patch (i.e., the 1-year safe driver patch) is 1 calendar year without a preventable accident. Subsequent awards are based on each additional calendar year without a preventable accident.

MARTA's system allows operators to remove records of preventable accidents from their personnel file after a period of safe driving. To remove one or more preventable accidents from an operator's personnel file, the operator must operate a bus without having a preventable accident for *2 consecutive calendar years* following the year of the *most recent* preventable accident. When the operator achieves this goal, then the *earliest* preventable accidents are removed from the operator's personnel file. After each additional year of operating without preventable accidents, the records of subsequent years' preventable accidents are removed from the operator's personnel file. For example, if an operator had preventable accidents in 1995 and 1996 and then operated without a preventable accident in 1997 and 1998, the preventable accidents from 1995 would be removed from the operator's personnel file. If the operator continued to operate without preventable accidents in 1999, the preventable accidents from 1996 would be removed from the operator's personnel file.

All full-time MARTA bus operators are eligible to receive a quarterly safety bonus of $30 if they attend two safety meetings and have no preventable accidents during the quarter. Operators receiving three consecutive bonuses are eligible for a $100 premium bonus as a fourth award. The maximum safety bonus in any year is $190; after receiving the maximum bonus, the employee begins eligibility for the next year. The safety and training department is responsible for maintaining and verifying safety meeting attendance records to determine eligibility for these payments.

MARTA makes a major commitment to its bus operator (and mechanic) roadeo program. MARTA starts off with more than 100 operators who have had no preventable accidents over the most recent 12-month period. Using additional screens, such as number of sick days, suspensions, and customer complaints, MARTA selects 15 bus operators for roadeo participation. The winner and runner-up are sent to APTA's International Roadeo competition.

Monitoring and Managing Bus Operator Safety Performance

MARTA has a strict disciplinary code for excessive preventable accidents that occur within a consecutive 24-month period, as follows:

- For *one* preventable accident in 24 months, the operator receives instruction from the safety and training department and a 1-day suspension;
- For *two* preventable accidents in 24 months, the operator receives instruction from the safety and training department and a 5-day suspension; and
- For *three* preventable accidents in 24 months, the operator is discharged.

In addition to these basic disciplinary procedures, any bus-to-bus accident will result in either a 10-day suspension or discharge. MARTA also clarifies in its disciplinary code that *any* preventable accident could be a dischargeable offense, depending on the severity of the accident and the degree of the operator's neglect.

Operators involved in any accident resulting in injuries or with damage exceeding $2,500 are tested for drug use.

MARTA's safety and training department has formulated a series of questions that help determine preventability and also help teach operators the meaning of defensive driving. The supervisor or other individual responsible for determining preventability is instructed to gather the facts about an accident and then apply the questions when making the determination. Figure 2 presents MARTA's interview questions to determine preventability.

MARTA's definition of defensive driving, as contained in the instructions accompanying the use of the interview questions, provides clear guidance to both operators and supervisors. These instructions include the following text:

> A defensive driver is one who makes allowances for the lack of skill and lack of knowledge on the part of the other driver, who recognizes that he has no control over the unpredictable actions of other drivers and pedestrians, nor over conditions of weather and road, and who, therefore, develops a defense against all these hazards; he concedes his right of

I. Intersection Accidents
   1. Did our operator approach the intersection at a speed safe for the conditions?
   2. Was he prepared to stop before entering the intersection?
   3. At a blind corner, did he pull out slowly, ready to shift his foot to the brake pedal?
   4. Did he make sure the other driver would stop for a traffic light or stop sign?
   5. Did he obey all traffic signs?
   6. Did he signal well in advance of his change in direction?
   7. Did he turn from proper lane?
   8. Was he alert for the turns of other vehicles?
   9. Did he avoid overtaking and passing in the intersection?
   10. Did he refrain from jumping the starting signal or riding through the caution light?

IF THE ANSWER TO ANY QUESTION IS "NO," OUR OPERATOR WAS NOT DRIVING DEFENSIVELY AND IS AT FAULT.

II. Hit Other in Rear
   1. Was our operator maintaining the safe following distance, namely one bus-length for every 10 miles per hour of travel, which should be doubled at night and doubled again in wet weather?
   2. Was he keeping his eyes and mind ahead of the car ahead?
   3. Did he approach the green traffic light cautiously, expecting the driver ahead to stop suddenly on the signal change?
   4. Did he keep from skidding?

IF THE ANSWER TO ANY QUESTION IS "NO," OUR OPERATOR WAS NOT DRIVING DEFENSIVELY AND IS AT FAULT.

III. Backing Accidents
   1. Was it necessary to back?
      a. Did our operator have to park so close to the car ahead as to require backing to leave the parking space?
      b. Was it necessary to drive into the narrow street, dead-end street, or driveway from which he backed?
      c. Did he back immediately after looking?
   2. Did he use his horn while backing?
   3. Did he look to the rear without depending on the rear vision mirror?
   4. If the distance was long, did he stop, get out, and look around occasionally?

Figure 2. Metropolitan Atlanta Rapid Transit Authority's interview questions to determine preventability.

IV. Pedestrians
1. Did he drive through congested sections expecting that pedestrians would step in front of his bus?
2. Was he prepared to stop?
3. Did he keep as much clearance between his vehicle and parked cars as safety permitted?
4. Did our operator refrain from passing vehicles that had stopped to allow pedestrians to cross?
5. Did he refrain from jumping the starting signal or riding through the caution light?
6. Was he aware of groups of children, and was he prepared to stop if one ran into the street?
7. Did he give all pedestrians the right-of-way?

V. Pulling from Curb
1. Did our operator look to front and rear for approaching and overtaking traffic immediately before starting to pull out?
2. Did he look back rather than depend upon rear vision mirror?
3. Did he signal before pulling from curb?
4. Did he start out only when his action would not require traffic to change its speed or direction in order to avoid him?
5. Did he continue to glance back as he pulled out?

VI. Skidding
1. Was our operator driving at a speed safe for condition of weather and road?
2. Was he keeping at least twice the safe following distance for dry pavement; one bus length for every ten miles per hour of speed?
3. Were all his actions gradual?
4. Was he expecting or alert for loose gravel, grease, oil, etc.?

VII. Parked
1. Was our operator parked on the right side of the street?
2. Was it necessary to park near the intersection?
3. Did he have to park on the traveled part of the street, on the curve, or on the hill?
4. Where required, did he warn traffic?
5. Did he park parallel to curb?
6. Was it necessary to park so close to alley or directly across from driveway?

VIII. All Others
1. Could our operator reasonably have done anything to avoid the accident?
2. Was his speed safe for the conditions?
3. Did he obey all traffic signals?
4. Was his vehicle under control?

IF THE ANSWER TO ANY QUESTION IS “NO,” OUR OPERATOR WAS NOT DRIVING DEFENSIVELY AND IS AT FAULT.

Figure 2. (*Continued*)

way and makes other concessions to avoid a collision; he is careful to commit no driving errors himself and is defensively alert to avoid the accident traps and hazards created by weather, roads, pedestrians, and other drivers.

Neither slippery roads, curves, hills, narrow roads, the absence of signs or signals, signals out of order, nor carelessness, recklessness or ignorance on the part of others relieves the driver in the slightest degree of his responsibility for driving without an accident. These are situations likely to be encountered at any time, and we must drive accordingly.

All accidents are reviewed by a division superintendent, who uses the guidelines in Figure 2 to determine preventability and write a report. In 1998, MARTA revised its procedures for operator appeals of a finding that an accident was preventable. MARTA has reformulated and renamed the Protest Committee into the Bus Accident Review Board. There are three management representatives on the board: the Bus Safety Officer (who chairs the board), the bus training instructor, and a bus superintendent. The union selects two bus operators as its representatives and two other bus operators as alternates. The chair of the board conducts the meetings, but only votes in the event of a tie.

The bus transportation manager who originally determined preventability has up to 10 min to present his or her findings.

The operator has the same amount of time to present his or her side of the story. Meetings of the board are scheduled quarterly, unless there is a backlog of appeals, requiring more frequent meetings.

MARTA's 32 bus line supervisors conduct random checks of bus operator driving performance. They also conduct checks in response to specific passenger complaints. The checks are usually conducted by following the bus and observing the operator's driving behavior. The line supervisors also use radar guns to make speed checks on MARTA buses. The safety and training department also conducts its own random audits of bus operations and radar speed checks.

A representative from customer service is occasionally assigned to ride with the operators to assess interactions with the riding public.

MARTA also maintains a bus operator accident database, which can be used to examine each operator's safety performance and accident history.

Bus Technology Safety Improvements

MARTA has experimented with a new rear brake light configuration. They originally used an 8-in. center brake light that flashed when braking. This light was subsequently removed, and MARTA modified their existing amber and red lights (at eye level of a following auto driver) so that they flash when the bus is braking and when it is stopped. MARTA has not yet collected sufficient data to determine the effectiveness of this new configuration.

MARTA is also experimenting with reflective tape on the sides and at the rear of the bus to increase bus visibility to other drivers.

MARTA has limitedly used video cameras, initially installing them on three MARTA buses. MARTA's long-range plan is to expand the video camera program; however, no data are available yet regarding the safety effects of the program.

MARTA uses its automated vehicle location (AVL) system, installed on approximately 200 buses, to improve safety. If an emergency occurs on a bus that is operating off route, MARTA dispatchers quickly locate that bus using the AVL system.

Safety Improvements in the Operating Environment

The safety and training department helps conduct safe operation checks of new routes. This process typically involves going out with a bus and an experienced operator to determine if there are any potential safety issues, such as traveling on narrow streets and needing to make overly tight turns.

MARTA is currently phasing out its 4-ft-tall bus stop signs because patrons were found to lean on these bus stop signs, causing the signs to protrude into the street, where they were subject to being struck by a bus or other vehicles. The bus stop signs are being replaced with U-channel posts, approximately 2 in. wide and 6 ft tall. Metal, reflective MARTA flags are being placed at the top of these posts. The U-channel post is similar to the sign post used by the city's traffic department; therefore, MARTA has added a braille symbol to assist visually impaired people in identifying MARTA bus stops.

Specialized Safety Practices

Any emergency alarm from a bus operator causes both a bus supervisor and a transit police officer to respond. The AVL system is very helpful in locating the buses under emergency conditions, particularly if the operator has gone off the regularly scheduled route or, for some reason, is unable to communicate.

MARTA has reduced the risk of injury to patrons by requiring that all strollers be folded before they enter the bus and left folded until they exit the bus.

REGIONAL TRANSPORTATION DISTRICT

RTD has an extensive bus operation, with approximately 860 buses operating during peak service over a six-county service area. RTD's bus routes cover mountainous terrain with many steep grades.

The weather in the RTD service area creates extremely difficult operating conditions for transit buses. The area is subject to extreme cold and snow during the winter, creating particularly hazardous bus-operating conditions.

Management Approach to System Safety

RTD's approach to safety in its bus operations, as within its rail operations, is incorporated into its system safety program plan. This plan sets the general safety policy and approach to achieving safety in operations and maintenance. The details of implementing the safety approach are spelled out in operating procedures and operator bulletins, which are not included in the system safety program plan.

RTD's management approach to safety in bus operations is based on early detection and resolution of safety problems through a safety committee comprising bus operators and management staff. The safety committee involves all of the key departments, including operations, maintenance, and facilities. RTD has found that this arrangement allows management to more easily resolve safety problems that cut across various functional areas. The major focus of the committee is on addressing and resolving operator-related issues that affect the safety of the public and employees.

Safety issues and problems that are not resolved at the safety committee level can be brought up at the quarterly senior management safety meetings. This type of high-level resolution is rarely necessary.

RTD's General Manager is also able to receive direct input on safety issues and problems through regularly scheduled employee forums. Employees are encouraged to speak on any issues at these forums, particularly on issues concerning safety.

RTD has also formed a committee to address issues related to the 1996 FTA regulation for state safety oversight of rail operations. This committee, the Safety Oversight Committee (which was previously called the Committee on Safety Certification Review), has recently had its mandate broadened to include bus operations.

Finding and Hiring Bus Operators

RTD, like many other transit systems, is having difficulty finding highly qualified bus operator candidates. This difficulty is reflected by the fact that RTD will consider candidates from the BOSS screening test down to the fourth level, which designates candidates as "potentially poor." The developers of the BOSS screening test recommend that these Category 4 candidates, with marginally acceptable scores for attendance and safety, need to be carefully screened through an in-depth interview process. RTD conducts detailed interviews with all of its bus operator candidates.

RTD hires all operators on a part-time basis. Newly hired operators must wait approximately 5–7 months before achieving full-time status. An increase in the number of full-time bus operator positions would help reduce the shortage of operators, but this increase would also cause problems in creating efficient schedules.

The major sources used to find operator candidates are advertisements in two major newspapers and an employee referral program. Current RTD employees can receive up to $250 if an applicant referred by the employee becomes an RTD bus operator.

The basic steps in RTD's bus operator hiring process include the following.

1. Review employment application and motor vehicle record.
2. Conduct brief initial interview.
3. Administer BOSS screening test and map test.
4. If applicant passes map test, send BOSS test answer sheets to the test development company for scoring.
5. Categorize candidate names according to scoring, as follows:
   - Category 1—best candidates (high attendance scores),
   - Category 2—potentially strong candidates (high attendance scores),
   - Category 3—potentially strong candidates (high safety scores),
   - Category 4—potentially poor candidates (passing attendance and safety scores), and
   - Category 5—low probability of success candidates (low attendance and safety scores).
6. Invite candidates from Categories 1–4 for an in-depth personal interview with a recruiter and a street supervisor.
7. Send qualified candidates to a DOT physical and drug test. (The physical includes a range-of-motion test to ensure that the candidate is physically capable of performing all operator functions.)
8. Conduct a criminal record background check and a reference check.
9. Send the candidate an offer of employment.

RTD estimates that it currently needs more than 150 new bus operators.

Training and Retraining Bus Operators

RTD has a 6-week program for training new bus operators. This program uses a mix of classroom and behind-the-wheel training. The training includes films from other agencies (such as "Defensive Driving DDC-5, Coaching the Transit Bus Operator," from New Jersey Transit [NJ Transit]) and RTD's own in-house films on such topics as tire damage, articulated bus operations, winter driving, and chain installation.

Figure 3 outlines the first 2 weeks of the RTD training program. A key element in the RTD training program is the use of standard operating procedures and employee rules and policies. These procedures, rules, and policies are documented in the *Trailblazer*, a comprehensive manual with procedures and guidelines for every aspect of bus operations, including the performance code, passenger relations and interaction, ADA requirements, personnel practices, operating procedures, emergency and legal procedures, equipment care and operation, personal appearance, radio procedures, fares, transfers, passes, operation procedures, routes, maps, diagrams, maintenance tips, fleet data, and street guides.

The *Trailblazer* is updated on an as-needed basis by the service planning and scheduling department. Transportation bulletins commonly address day-to-day issues.

During the first 3 weeks of training, each trainee takes eight graded classroom tests. The grade point average (GPA) for these tests must be 3.0 or higher to continue with the class and move into revenue training for Weeks 4 and 5. The overall GPA for the entire course is computed using the eight classroom tests (they make up 50 percent of the overall GPA), a final test in Week 6 (it makes up 40 percent of the overall GPA), and the CDL road test (it makes up 10 percent of the overall GPA). The order of choice of assignments to operating divisions is determined by the student's overall GPA.

RTD's usual practice has been to schedule driver refresher training on a yearly basis. Because of the current shortage of operators, RTD now restricts its retraining efforts to operators involved in a preventable accident. Typically, retraining involves 1 or 2 days to review the specific causes of the accident, receive special training to correct specific driving problems associated with the accident, and complete another defensive driving course.

Week 1
Hours are 6:00 a.m. - 2:30 p.m. daily
You must be punched in and in your seat in the classroom no later than 6:00 a.m., or a miss will occur.
Reminder: casual clothes are recommended
Topics covered:
Defensive driving DDC-5 Coaching the Transit Bus Operator (A New Jersey Transit film)
CDL Pretrip
Student responsibility, discipline, etc.
Detour sheet
Bulletins and See Me list
Safety
Accident reports
Street numbering system (100 blocks)
Traincards
Route maps and instruction
Fares
DOT defect reports
Tire damage (in-house film)
Bus maneuvers (Workbook)
Driving a 40-foot bus
Practice work will be available daily, to include:
- Reading from Trailblazer and New Operator Workbook
- Worksheets (in workbook)
- Entering 100 blocks in Trailblazer
- One graded test

Uniform certificates will be issued - uniforms will be required beginning in the second week.

Week 2
Hours are 6:00 a.m. - 2:30 p.m. daily
Exception: Late day - Thursday, _____ (9:00 a.m. - 5:30 p.m.)
(Uniforms required)
Topics covered:
- Lift procedures - body mechanics for loading & securing mobility devices. (in-house film)
- Runboard
- Transfers & transfer points
- Farebox
- Smarttrack radio system
- Traincards (continued)

Three graded tests will be administered
Entering 100 blocks in Trailblazer will continue
Practice work will be available daily

Division selection options will be discussed

Figure 3. Outline of Regional Transportation District's training program: Weeks 1 and 2.

Providing Incentives for Safe Driving

Operators are recognized for safe driving through the award of patches, commendations, and other awards and recognitions. RTD considers safe driving to include no chargeable occurrences under Article 212, "Accidents," and Article 214, "Improper Operation of Vehicle," of the *Trailblazer.*

Operators violate Article 212 if they are involved in a preventable accident or if they fail to report promptly any personal injury incurred on duty or on district property or equipment. Article 214 violations include reckless driving (i.e., Class A infraction), careless driving (i.e., Class B infraction), violation of published rule for safe and courteous operation (i.e., Class C infraction), failure to answer radio call or turn on interior lights during hours of darkness (i.e., Class D infraction), and failure to display proper signage or unnecessary conversation with passengers while vehicle is in motion (i.e., Class E infraction).

RTD's disciplinary process for Article 212 violations is based on a point system that distinguishes between two classes of preventable accidents:

- Class I: preventable accidents causing $1,000 or more in damage to RTD property; preventable accidents with

injuries to passengers, pedestrians, or other members of the public; or preventable accidents causing $1,000 or more in non-RTD property damage.
- Class II: preventable accidents causing less than $1,000 in damage and preventable accidents without injuries.

Bus operators receive disciplinary points for having preventable accidents. Table 5 shows how these points are calculated. Disciplinary action is based on the accumulation of points. Table 6 shows how disciplinary action is determined.

RTD has similar disciplinary procedures for violations of Article 214.

Monitoring and Managing Bus Operator Safety Performance

The first line of monitoring is conducted by RTD's Safety Compliance Officer for Bus Operations. This officer reviews all bus operator accident and incident reports to determine if further evaluation and follow-up is needed to correct hazards. Much more intensive monitoring is provided for more serious accidents through RTD's Accident Investigation Team (AIT). AIT comprises three separate units with different expertise for different accident situations:

- **AIT Standing Committee.** AIT Standing Committee comprises senior RTD staff, including the Risk Manager (who is the team leader), the Superintendent of Transportation, the Superintendent of Maintenance, the Safety Supervisor or Safety Compliance Officer, the Liability Claims Supervisor, and the Manager of Dispatch or Street Supervisor.
- **AIT for Vehicle Accidents.** AIT for Vehicle Accidents comprises
  - A liability claims representative,
  - The Street Supervisor or Manager of Dispatch,
  - A safety representative,
  - The Division Maintenance Manager from the operator's division (if the operator alleges a mechanical defect was a factor or if there was extensive damage to the bus),
  - The Division Transportation Manager from the operator's division (for potential fatality, extensive property damage to bus or property, alleged gross negligence of operator, or any accident involving two or more company vehicles), and
  - A technical services representative (for alleged mechanical defect).
- **AIT for Other Property.** AIT for Other Property comprises
  - The Risk Manager (who is the team leader),
  - The Division Maintenance Manager from the facility where the accident occurs,
  - The Safety Supervisor,
  - The Facility Maintenance Supervisor of the facility where the accident occurs,
  - The Liability Claims Supervisor,
  - The Security Manager, and
  - The Street Supervisor or Manager of Dispatch.

TABLE 5 Regional Transportation District's calculation of disciplinary points

Accidents in 12-Month Period	Number of disciplinary points given to the operator	
	Class I	Class II
1	5	2
2	10	5
3	10	8
4	10	10
5	—	10

TABLE 6 Regional Transportation District's determination of disciplinary action

Number of Points in 12-Month Period	Disciplinary Action
2 - 10 points	Caution and instruction
11 - 16 points	One day unpaid suspension and one day of training and DDC
17 - 26 points	Two days unpaid suspension and two days retraining, and warning letter
27 - 34 points	Three days unpaid suspension and final warning letter

AIT Standing Committee's primary responsibilities are to provide overall leadership to AIT; approve major procedural and program changes; and provide a well-planned, well-staffed team with related expertise for major accident review. AIT Standing Committee also reviews overall accident data for the prior period to analyze, identify, and offer solutions to safety and other risk control problems. AIT Standing Committee meets when requested by the Risk Manager or Safety Compliance Officer. Any committee member may require, with the agreement of the Risk Manager, that the Standing Committee be called into special session.

AIT for Vehicle Accidents is mobilized when either the responding supervisor or the dispatcher, using information from the scene, has determined that additional assistance and RTD representation is warranted. The criteria used for making the determination are

- Fatality or serious bodily injury (e.g., overnight hospitalization) resulting from an RTD vehicle accident and
- Extensive property damage resulting from an RTD vehicle accident (damage must be severe, indicating structural damage to the vehicle[s], or building involved).

AIT for Other Property is only mobilized when there is major damage to real property owned by RTD (i.e., when such damage causes a halt in operations).

RTD maintains a complete accident history for each bus operator. These data are reviewed as part of the follow-up after an operator has one or more preventable accidents or

other violations to determine if there are any trends or patterns developing.

RTD conducts ride checks of operator driving performance only when there are specific customer service complaints or concerns. RTD periodically uses personnel on-board for security-related purposes.

Bus Technology Safety Improvements

RTD's maintenance and transportation departments work very effectively and responsively to resolve any safety issues that arise, including issues with safety equipment and features required on transit buses.

RTD has equipped 65 transit buses with video cameras. Video images are recorded in analog format into VHS videotape recorders or in digital format onto a computer hard drive. The primary reason for installing video cameras is related to security, specifically the video cameras' effectiveness in reducing vandalism and other disturbances on the buses.

RTD has found that the recorded video images are also very useful in resolving problems involving passenger safety and passenger complaints. Review of the recorded images can help to determine actual events when there are conflicting versions of a safety incident.

Safety Improvements in the Operating Environment

RTD uses its safety committee process to identify any specific problems related to the operating environment. Such problems may include the placement of bus stops and other safety aspects of new and existing routes.

RTD uses a set of detailed guidelines for designing bus stops, including both far-side and near-side (relative to street intersection) stop locations. RTD has used the results of TCRP Project A-10, "Location and Design of Bus Stops on Major Streets and Highways," as a reference for developing RTD's own detailed designs.

KING COUNTY METRO TRANSIT

Metro Transit is the largest of the transit bus operations to be profiled, with approximately 1,100 buses operated during maximum revenue service. Metro Transit has six separate transit bus maintenance and storage facilities serving more than 200 bus routes throughout the Seattle metropolitan area.

Metro Transit buses operate in temperate weather conditions with average maximum temperature ranges from the mid-40s to the mid-70s °F, and minimum temperatures from the upper-30s to the mid-50s °F. Most rainfall occurs from late fall through early spring, while summer is generally dry. The area's average annual rainfall (39 in.) is less than that of most cities in the eastern United States. There are occasional instances of snow or icing conditions resulting from temperatures in the 20s °F. Route topography is highly variable, including many routes in downtown Seattle with steep grades.

Management Approach to System Safety

Metro Transit's system safety program plan provides a concise description (in approximately 80 pages) of the management and administration of the safety program. For example, the safety-related responsibilities of the safety section and operations section are presented as follows.

- **The safety section** includes system safety plan procedures, system safety data, hazard identification and resolution, accident investigation and analysis, safety education, safety interaction, incentive awards, roadeo, safety committees, accident rereads, and accident review board.
- **The operations section** includes route modification, testing, driver selection, pretrip, coach defect reports, road hazard reporting, accident reporting system, accident data, driving skill re-examination, and nonrevenue vehicle operation.

Senior management at Metro Transit receives a monthly accident report summary that presents, in three pages, a concise picture of transit safety trends. Accidents are categorized as traffic (i.e., collision) or passenger (i.e., personal casualty). The report also presents data on the number of preventable accidents, subdivided into minor, major, or severe accidents.

The report also presents information on nonrevenue accidents, time loss and medical injuries for employees, and the costs associated with collision damage to the transit buses. Basic operations data are provided, including the number of bus operators, miles operated, passengers carried, and total platform hours. Metro Transit uses the following measures for accident data:

- Number of accidents per million miles operated,
- Number of accidents per day,
- Number of miles per accident, and
- Number of platform hours per accident.

Accident trends are illustrated in the monthly accident report summary by percentage changes in month to month (i.e., the number of accidents in the current month compared with the number in the same month last year) and in year to date (i.e., the number of accidents in the current period compared with the number in the same period last year). The report also has a graphic illustration of the frequency of traffic, passenger, and total accidents using both month-to-month and year-to-date formats.

Finding and Hiring Bus Operators

Metro Transit hires all bus operators on a part-time basis. Because of a dramatic expansion in service hours over the

last 5 years, Metro Transit has found it necessary to move part-time operators to full-time status in a shorter period of time. The human resources department estimates that the average time on the job before reaching full-time status is currently about 10 months; the historical, long-term (i.e., over the last 10 years) average duration had been approximately 36 months.

Metro Transit's human resources department has completely re-engineered its hiring process to accommodate the need for many new bus operators. Despite record low unemployment in King County, Metro Transit's human resources was able to hire 298 new operators in 1998 and nearly doubled that figure in 1999. The human resources department has noted that it has been able to hire these new operators while actually raising their standards in the screening process, as explained later in this section.

Metro Transit uses a wide variety of sources to attract qualified candidates, including radio ads and large display ads prepared by Metro Transit's marketing department. The agency has found, however, that the best way to attract candidates is by word of mouth, including employee referrals. Metro Transit also extensively uses community-based organizations serving various ethnic populations and state-operated employment centers to reach potential candidates.

Employment applications are readily available at Metro Transit offices, on buses, and at the community-based organizations; the application is even available for downloading from the Internet. Interested individuals are encouraged to call Metro Transit's operations hotline, where they can get further information or make a reservation to attend a 1-day orientation and testing program at Metro's test center. Metro currently schedules 2 days per week for orientation and testing.

One of the major changes in Metro Transit's hiring process has been in screening applications. Previously, Metro Transit would examine and screen applications prior to testing. Under the new procedures, Metro Transit does not look at the application until the individual comes in for orientation and testing. This change has made the overall hiring process more efficient.

The candidate-screening process at the test center is as follows:

- Employment application must be complete;
- Candidates attend a brief orientation, which explains the duties of a Metro Transit bus operator and the requirements for becoming an operator;
- Candidates take Metro Transit's video screening test, which emphasizes passenger relations;
- Candidates attend a CDL presentation by the Washington State Department of Licensing;
- Candidates are interviewed by a panel consisting of the base (i.e., bus facility) chiefs using structured interview questions plus informal in-depth inquiry, as required;
- The last part of the interview consists of a reading comprehension test; and
- Candidates provide fingerprints for criminal records checking.

In 1993, human resources raised the standard for passing the passenger relations video test from 182 to 200. This increase in standards has proven to be very successful in screening out candidates who may have the requisite mechanical skills to operate the bus, but who eventually leave Metro Transit because they do not have the "people skills" that are essential to the job.

The best measure of success for a hiring process is a very low turnover rate. Metro Transit has achieved an annual turnover rate as low as 1.8 percent. However, because of the extremely competitive hiring environment in the Seattle area, Metro Transit is currently experiencing an approximate 7–8 percent turnover rate.

The human resources department also believes that it has established a very effective process for conducting reference checks. Its highly trained staff interviewers are usually able to obtain relevant information from as many as four or five previous employers. This success is attributed to the interviewers' telephone interviewing techniques.

An offer of employment is made to all candidates whose references prove to be valid and acceptable. Upon acceptance of the offer, Metro Transit obtains a 5-year abstract of the candidate's driving and criminal record from the Washington State Police. The candidate is sent for a CDL pre-employment physical, including drug and alcohol tests, and must take the CDL written test. If the candidate passes all the tests and checks, the candidate is hired.

The human resources department estimates that only about 20–25 percent of the initial applicants make it through the entire hiring process: up to 50 percent drop out (or are dropped) before they reach the panel interview stage; approximately 10 percent are dropped as a result of the interviews; and another 10–15 percent are dropped as a result of the reference checks. When those statistics are combined with the dropout rate during operator initial training (an estimated 25–28 percent), Metro Transit's low turnover rate for bus operators is not surprising.

Training and Retraining Bus Operators

Metro Transit initiates operator training with its 22-day training course for part-time operators. The course consists of 8 days of classroom instruction (4.5 h per day), 4 days of standard and articulated coach practice (8 h per day), 2 days of skills tests (2 h per day), 5 days of in-service route training (up to 8 h per day), 2 days off, and 1 qualification day (3.5 h). Figure 4 presents the classroom topics and schedule for the first 4 days of training. For the in-service training, Metro Transit is unusual (for a large system) in that it allows a new operator to select a specific route for the initial part-time assignment.

Metro Transit extensively uses videos in its training program. The following sequence of videos is used over the 8 days of training:

DAY ONE — FRIDAY

1.	Personal Data Form	5 minutes
2.	Training Schedule	15 minutes
3.	Training Standards	20 minutes
4.	Class Introductions	20 minutes
5.	Introduction to Bike Rack and Coach Interior	60 minutes
6.	Service Handout	20 minutes
7.	Introduction to Metro Coaches	20 minutes
8.	Coach Operation Rules	60 minutes
9.	Coach Practice Preparation	20 minutes

(Three 10 minute breaks as needed)

DAY TWO — MONDAY

1.	Coach Practice Review	20 minutes
2.	Introduction to Metro Terminology	50 minutes
3.	Introduction to the Book	50 minutes
4.	Base Routes and Run Card	60 minutes
5.	Preparing for Work	60 minutes

(Three 10 minute breaks as needed)

DAY THREE — TUESDAY

1.	Review	10 minutes
2.	The Pick	20 minutes
3.	Skills Test Sign-up	10 minutes
4.	Operating in the Base	25 minutes
5.	Lost and Found	10 minutes
6.	Surface Street, Freeway, and Stopping for Customers	60 minutes
7.	Drug Awareness	95 minutes
8.	Quiz #1	30 minutes

(Three 10 minute breaks as needed)

DAY FOUR — THURSDAY

1.	Easy Riding Video	30 minutes
2.	A.D.A. Training	4 hours

(Three 10 minute breaks as needed)

DAY FIVE — FRIDAY

1.	Review	20 minutes
2.	Rules for Customers	20 minutes
3.	Radio Training	120 minutes
4.	Accidents	60 minutes
5.	Quiz #2	30 minutes

(Two 10 minute breaks as needed)

Figure 4. Metro Transit's classroom topics and schedule for the first 4 days of training.

- Day 1: "Bike Rack,"
- Day 2: "Check It Out,"
- Day 5: "Emergency Alarm,"
- Day 6: "Regional Reduced Fare Permit," and
- Day 7: "Issue is Respect" (video and manual).

The next step in the operator-training sequence is the refresher training course for part-time operators. All Metro Transit part-time transit operators have to take this 8-h course (given either as one 8-h segment or as two 4-h segments on 2 consecutive days) within 30–45 days from their qualification date. Class size is limited to a maximum of six operators.

The refresher training covers three segments.

- **Introduction to the Metro system.** This segment provides information and classroom practice in basic operational and administrative procedures to allow new operators to build confidence in using the system.

- **Back power.** This segment is designed to assess the transit operator's overall back health and provide exercises to maintain and strengthen back muscles.
- **Customer relations.** This segment provides new operators with the basics of customer service. Course participants view "The Guest," a video that defines customer relations through five basic skills. This course segment also includes "Injury Avoidance," a unit that teaches self-defense and verbal strategies in diffusing difficult situations on the coach.

Metro Transit has a number of specialized training units that are specific to particular transit coaches and operating situations. For example, one course unit teaches transit operators how to operate the Breda 5000 series coach (a dual-mode vehicle, electric and diesel-powered), which is used in the downtown Seattle Transit Tunnel. There is also a companion course on operating procedures in the tunnel. Metro Transit has a short course (20 min) on the correct use of the Recaro Seat (a fully adjustable driver's seat) and driver's station controls, which have both been retrofitted into an articulated coach.

Metro Transit provides retraining for individual operators whose accident record indicates that such action is required. In the transit operator retraining session, Metro Transit assigns one operator per transit instructor over 3 days, 8 h each day.

The training department views retraining as part of the positive performance counseling program for operators. It is designed to help the individual operator correct poor driving habits through additional training. As such, retraining takes a positive, rather than punitive, approach to improving an operator's performance.

The retraining session follows a standard outline for the 3-day session. The standardized format (open discussion, viewing of specific videotapes, review of safe driving skills, coach practice, and 8-h driving assignment) is designed to assess and help correct poor driving habits and skill deficiencies that contribute to the operator's preventable accidents. The format also provides a comprehensive review of safe driving techniques.

Within the standard outline, there is room for flexibility and customized instruction directed at the operator's skill level and accident record. The instructor identifies areas of weakness and concentrates on improving these areas through the two specialized coach practice sessions. The purpose of retraining is to return the employee to the workplace with the knowledge, skill, and attitude necessary to avoid accidents.

Providing Incentives for Safe Driving

Metro Transit has several incentive programs for safe driving, including the following.

- **Safe driver recognition program.** This program is structured to recognize full-time and part-time transit operators having perfect safety records. Transit department management presents custom-designed awards to operators without preventable accidents at special award presentations held up to four times annually.
- **Bus roadeo.** The bus roadeo is a competitive test that measures the transit operator's driving skill behind the wheel, knowledge of safety regulations, and knowledge of bus equipment used. It includes the following: written safety quiz, personal appearance and grooming rating, pretrip bus inspection, driving test, and eligibility requirements.
- **Safety meetings.** Monthly safety meetings are held at each operating base to discuss current safety topics.

The awards under the safe driver recognition program start with a bronze belt buckle after completion of 3 years without preventable accidents; an operator receives a new number panel for the belt buckle for the 4th through 45th years of safe driving. The custom-designed awards include a watch (10th year), ring (20th year), and a mantle clock (30th year).

The awards for the bus roadeo's first place winner include a trophy, a $300 savings bond, dinner for two at an awards banquet, and an all-expense-paid trip for two to the Northwest Invitational, the State Roadeo, and the International Bus Roadeo competitions. Second through tenth place winners also receive awards, including $200 (2nd place) and $100 (3rd place) savings bonds, dinner for two at the awards banquet, and all-expense-paid trips for two to the Northwest Invitational Roadeo competition.

Food and refreshments are provided to employees who attend the monthly safety meetings, as a form of payment for attending the meeting on personal time.

Monitoring and Managing Bus Operator Safety Performance

Metro Transit has a structured and comprehensive approach to monitoring bus operator performance through ride checks. A complete description of this approach is presented in a 9-page document, "Standards for Performing Ride Checks."

To conduct the ride check, the instructor rides the transit operator's coach during a portion of the operator's regular in-service route. The instructor rates the operator's driving skills, knowledge of Metro procedures, and customer relations. A checklist form, the *Ride Check Report*, is used for recording the results of the ride check, with space available for comments. The completed report is given to the training chief for review and then forwarded to the operator's supervisor to become part of the operator's personnel file.

The ride checks are scheduled according to the following priority list.

- **Student rides:** at least 45 min long, two or three rides per student.
- **First rides:** at least 30 min long.

- **Accident rides:** allow sufficient time to discuss accident and contributing factors.
- **Probationary rides:** at least 30 min long; at 4 months, 6 months, and 12 months.
- **Tunnel rides:** at least 30 min long.
- **Annual rides:** at least 30 min long.

There are three acceptable grades on the ride check form.

- **Satisfactory (S):** the operator has performed a particular skill or duty to Metro standards.
- **Reinstructed (R):** the operator performed the skill or duty in a less-than-satisfactory manner and was reinstructed.
- **Not applicable (—):** the skill or duty was not observed or was not part of that day's assignment.

Metro Transit has a comprehensive process for determining the preventability of a bus accident. The process is summarized as follows.

1. **Safety officer determination.** A safety officer will review the information on the accident report and conduct any additional investigation or analysis that would be important in determining the preventability of the accident. The safety officer makes the judgement and forwards it by completing an evaluation notice, which is delivered to the base chief or supervisor for presentation to the employee.
2. **Accident Reread Committee.** Should an employee disagree with the judgement of the safety officer, the employee may request, within 7 days of notification, a second review (i.e., a reread) with a senior instructor or chief, union representative, and safety officer. The safety officer will not vote except in a tie. The employee will not be required to submit additional information for the second review. If additional information is available, the employee is strongly encouraged to provide it. It is understood that the purpose of the second review is to ensure a complete understanding on the part of the employee and the reread committee of the situation that occurred and to ensure a complete understanding of the appropriate action to address the issue.
3. **Accident Review Board.** An appeal of the reread decision can be made to the Accident Review Board with the approval of Metro management. The operator must personally request the appearance to the transit safety section within 10 days of the reread decision. The Accident Review Board will consist of two senior operators (or employees, if the appeal is not from base operations) with good driving records selected by the supervisor of transit safety and two supervisors from the operations department, service quality department, or training department. A safety representative will chair the appeal board, but will have no vote.
4. **National Safety Council Review (for extraordinary circumstances).** If there is a tie vote by the Accident Review Board in the judgment for the accident, the Accident Review Board will instruct the supervisor of safety to forward the matter to NSC for final determination. In the event that NSC, after its review, makes a nondeterminative finding, the accident will be classified in accordance with the Accident Reread Committee's decision.

After determining that an accident was preventable, the Metro safety officer determines the severity of the accident to assign points. The applicable points are used to determine the appropriate supervisory action to be taken. The following factors are taken into account when establishing the severity of an accident:

- Negligence,
- Injuries (to pedestrians, bicyclists, skate boarders, on-board passengers, or drivers or passengers in other vehicles), and
- Property damage (to the Metro vehicle, to other vehicles, or to nonvehicular property).

The Metro accident review process includes an analysis injury point system, which ranges from one point for a complaint of injury (but none visible) to 15 points for a fatality. If the injury is to a pedestrian or any individual using a nonmotorized vehicle conveyance, the injury point scores are doubled.

The decision on whether an accident is minor, major, or severe is based on a determination made by the safety department using a preventable accident analysis form, which is presented in Figure 5. As shown on the form, the total severity points computed by summing the severity points from each category (i.e., negligence, injuries, and property damage) lead directly to the determination of accident severity:

- **Severe accident:** 15 + severity points (which converts to 24 discipline matrix points).
- **Major accident:** 8–14 severity points (which converts to 7 discipline matrix points).
- **Minor accident:** 1–7 severity points (which converts to 5 discipline matrix points).

Disciplinary action is based on a 4-year period, working backward from the date of the latest preventable accident. Metro Transit uses the "discipline matrix" shown in Table 7. For example, if an operator has accumulated 21 discipline matrix points over the past 4 years, he or she will undergo retraining.

Operators receive counseling for all preventable accidents, regardless of the point score. The second time an operator requires retraining in accordance with the discipline matrix, a suspension is added to the retraining. Any operator receiving

Operators Name _____ I.D.#_____ Accident # _____

NEGLIGENCE

Disobedience of:	Severity Points	
Basic rules of defensive driving	3	_____
Company policy/statutes	5	_____
Operator sleepy	7	_____
Operator impaired (alcohol, drugs, etc)	15	_____

Comments/Description: _____
_____

INJURIES

Collusion	Severity Points	
No injury	0	_____
Complaint of injury - none visible	1	_____
Visible injury – nondisabling	2	_____
Disabling	3 or 5	_____
Fatal	15	_____

Comments/Description: _____
_____

Pedestrians	Severity Points	
No injury	0	_____
Complaint of injury - none visible	2	_____
Visible injury - none disabling	4	_____
Disabling	6 or 10	_____
Fatal	15	_____

Comments/Description: _____
_____

PROPERTY DAMAGE

Coach Repair Costs		Severity Points	
None	($0 - $90)	0	_____
Minor	($91 - $890)	1	_____
Moderate	($891 - $2,671)	3	_____
Major	($2,672 - $12,720)	5	_____
Severe	($12,721 or more)	7	_____

Figure 5. Metro Transit's preventable accident analysis form.

Other Vehicle (as determined by National Safety Council, "Vehicle Damage Scale for Traffic Accident Investigation")

		Severity Points	
None		0	_____
Minor		1	_____
Moderate		3	_____
Major		5	_____

Other (nonvehicular)		Severity Points	
None	($0 - $69)	0	_____
Minor	($70 - $398)	1	_____
Moderate	($399 - $1,219)	3	_____
Major	($1,220 - $12,720)	5	_____
Severe	($12,721 or more)	7	_____

Comments/Description:_____
_____

1 – 7 severity points - Minor
8 – 14 severity points - Major
≥ 15 severity points - Severe **Total Points** _____

List Other Significant Information:_____
_____
_____
_____

Safety Officer Statement:_____
_____
_____
_____

This accident classified:

1 - 7	severity points =	Minor Accident = 5 discipline matrix points
8 - 14	severity points =	Major Accident = 7 discipline matrix points
15+	severity points =	Severe Accident = 24 discipline matrix points

Safety Officer Recommendations:_____
_____
_____
_____

_____ _____
Safety Officer Date

_____ _____
Supervisor, Transit Safety Date

Figure 5. (*Continued*)

more than one suspension will receive a longer suspension for the second occasion or discharge.

An operator can deduct safe driving points off of his or her record for every 12 months of driving without any preventable accidents.

The Metro Transit Preventable Accident Review System presents an important model that other transit systems can consider for use, particularly because the model factors severity of the accident into the determination of corrective action (e.g., specialized training and assistance). Other transit systems have requested copies of the document from Metro, so other systems may use the same process or something very similar.

Metro Transit can monitor bus accident trends and operator safety performance very precisely because of its comprehensive on-line accident database and query system. Metro Transit can generate a wide variety of summary reports

TABLE 7 Metro Transit's discipline matrix

Number of discipline matrix points accumulated				Disciplinary Action Taken
Year 1	Year 2	Year 3	Year 4	
6–10	7–13	12–17	14–20	Ride Check
11–17	14–20	18–24	21–27	Retraining
18–23	21–26	25–31	28–34	Suspension
24 or more	27 or more	32 or more	35 or more	Subject to Discharge

directly from the accident database. For example, Metro Transit's safety section currently runs the following analyses as part of its standard summary reports:

- Summary of accidents by classification;
- List of accidents by location;
- List of accidents by work location and classification;
- Custom comparative summary by classification, location, operated route, work location, coach type, and fleet;
- Base competition summary;
- Fleet contest summary;
- List of accidents by route and run;
- List of accidents by base, coach type, and class;
- List of accidents by coach type, base, and driver; and
- List of accidents by driver.

Metro Transit's accident classification system consists of different codes for traffic accidents and passenger accidents. There are 42 separate codes for traffic accidents. These codes describe the circumstances of the collision or contact in great detail. For example, Metro transit can distinguish between four different types of accidents involving a Metro vehicle turning left:

- Type 207 (other vehicle from ahead),
- Type 208 (other vehicle from left),
- Type 209 (other vehicle from right), and
- Type 210 (other vehicle from rear).

There are 12 separate codes for passenger accidents, including two for boarding; four for alighting; and six for passenger falls when the bus is starting, stopping, turning, or stopped.

Metro Transit also uses another set of 34 internal codes that help to define the circumstances of each accident more precisely. The codes are very diverse, as shown in the following list of code examples (a small subset of the 34 codes):

- Code A (coach or coach accident),
- Code D (vehicle defect),
- Code I (ice or snow),
- Code N (left mirror side swiped in zone),
- Code S (school tripper),
- Code T ("tailswing" accident),
- Code X (fuel nozzle), and
- Code 1 (runaway coach).

Metro Transit's comprehensive accident classification system, combined with the other information in the accident database, provides an excellent basis for bus safety and accident analysis.

Bus Technology Safety Improvements

Metro Transit has decided to use LED brake lights at the rear of its new Gillig buses. An analysis of Metro Transit accident data showed that the LED brake lights effectively reduced the number of accidents in which another vehicle hits the rear of a bus. LED-equipped buses had a rear-end accident rate approximately 40 percent lower than that of buses with conventional brake lights.

Metro Transit has also selected the Recaro fully adjustable operator's seat as part of the new workstation design on its articulated coaches. The Recaro seat allows fore and aft adjustment, electric recliner adjustment, lumbar support controls, lateral support side bolsters, shoulder support, seat height adjustment, seat cushion angle adjustment, and a seat back release lever. Changes in the operator's compartment include a telescopic or tilt steering wheel and adjustable steering column, adjusted angle or position of brake and throttle pedals, left-side convex mirror, remote mirror control, driver's fans, parking brake, and hill holder.

Metro Transit police have recently been involved in a test of digital closed-circuit television (CCTV) systems from two different vendors. The test period started in May 1998 and ended in February 1999. The primary purpose of the test was to ascertain if existing on-board digital CCTV technology would deter criminal activity, provide reliable information for investigative purposes, withstand the rigors of the transit environment, and act as an effective risk management tool.

Metro police found that both vendors' products experienced a variety of problems. The problems were solved, although with considerable delays in many cases. Metro police concluded that digital CCTV is an emerging technology, with the expectation that continual upgrades, improvements, and other changes in the technology would be part of this industry into the foreseeable future.

Metro Transit plans to increase its use of digital CCTV on transit buses for the following reasons:

- Anecdotal data from Metro operators suggest that the presence of digital CCTV tends to reduce improper behavior,

- The quality of recorded images is sufficient to identify specific individuals engaged in improper behavior, and
- The availability of accurate recorded images can assist in reducing false claims associated with traffic and passenger accidents.

Safety Improvements in the Operating Environment

Metro Transit has a standardized approach to placing and designing bus stops. This approach is incorporated into Metro Transit's "Bus Stop Location and Design Guidelines." Major consideration is given to passenger, pedestrian, and vehicular safety in these guidelines.

A representative of the safety department works with a route planner when Metro Transit establishes new routes or makes major modifications to existing routes. One of the considerations in bus stop placement is avoidance of areas where there is a conflict with pedestrians. Metro Transit also wants to avoid placements that will create difficult operating conditions, such as placing a stop zone too close to a left turn on the route, thereby requiring the bus operator to cross traffic lanes in a short distance.

The safety department also examines a route for line-of-sight issues, accessibility requirements, and the need for pullouts.

CHAPTER 3

DIRECTORY OF EFFECTIVE PRACTICES USED TO PREVENT BUS ACCIDENTS

INTRODUCTION

This chapter describes accident prevention practices that are used and considered to be effective by transit safety managers, based on their responses to the request for information form and subsequent telephone interviews conducted during Phase I of this project. The accident prevention practices are presented in the form of a directory, where each practice is placed into one of the following categories (corresponding to the request-for-information form):

- Driver selection and hiring,
- Driver training,
- Safe driver incentive programs,
- Customer safety programs,
- Management practices and programs,
- Bus technology safety improvements, and
- Operating environment programs.

Each accident prevention practice is presented in a uniform format, identified by the appropriate category, containing the following information:

- **Summary description** of the accident prevention practice.
- **Sources or references.** Specific descriptions of different approaches, techniques, products, or technologies used by transit systems to implement the practice.
- **Evaluation of effectiveness.** Presentation of evaluation data regarding effectiveness of practice in reducing rate of accidents.
- **Transit system or other contacts.** Names and telephone numbers of the transit system personnel responsible for implementation of the practice. In certain instances, contact information is provided for vendors of specific services or technologies for the convenience of the reader. Contact information is correct as of the date of this report's publication.

The "transit system or other contacts" listed for each practice are not intended to be comprehensive. The information presented only represents partial results from selected transit systems.

The general decision factors used to select accident prevention practices for the directory included the overall ranking of effectiveness by transit safety managers, the availability of evaluation data, and the extent to which the practice represented new technology or some innovative approach that may not be well known in the transit industry.

The safety practices profiles presented in Chapter 2 and the contents of the directory are complementary products. The profiles present many of the standard and well-known industry practices that may not be covered in the directory. The directory is intended for use as a reference guide to enable the reader to quickly find information on a broad range of practices, some of which are not in extensive use.

DRIVER SELECTION AND HIRING

Personal Interviews

Summary Description

The personal interview is an integral part of the screening process for the selection of suitable bus driver candidates. Personal interviews are used by virtually all transit systems and are rated highly effective by the majority (i.e., 53 percent) of these systems. Personal interviews are ranked Number 5 in the list of effective practices by all participating transit systems.

The individuals conducting the interview should be thoroughly knowledgeable about bus operations and the requirements placed on the bus driver. The interviews should be conducted with a standardized set of questions to make sure that all pertinent information is properly addressed. The questions should cover general aptitude for and knowledge of critical job skills, applicant's integrity, personality, willingness to learn, and concern for the safety of people and property.

Sources or References

The only standardized set of personal interview questions that is available is the set included in BOSS, which is discussed further under screening tests.

The "Finding and Hiring Bus Operators" sections in Chapter 2 present information on the personal interview techniques

used by the exemplary safety performance systems. These interview techniques can be considered "best practices" for other transit systems of similar size seeking to improve their hiring process. Some other interview techniques identified in the Phase I data collection process are described below.

A small transit system (Pacific Transit) takes applicants throughout the entire operation and encourages them to speak freely about themselves to the drivers and other employees. The interviewer uses this opportunity to find out about the person and gauge how the candidate would interact with the public.

British Columbia Transit/(BC Transit) in Victoria makes a judgement on the "trainability" of an applicant (i.e., the ability to follow instructions and directions) during the course of an hour-long walk around the system, including a 10-min drive.

Evaluation of Effectiveness

Personal interviews are part of a process; therefore, the practice cannot be individually evaluated, unless there is a distinct change.

Transit System or Other Contacts

Pacific Transit	BC Transit	BOSS
Greg Moore	Terry Beatson	Rick Jacobs
(360) 642-2550	(250) 385-2551	SHL Landy, Jacobs, Inc.
		(814) 237-5997

Screening Tests

Summary Description

A number of screening tests in use are designed to assist transit systems in selecting the proper candidates to become trainee bus operators. The tests are just one part of an entire screening process where candidates progress from a review of their written employment application to an initial screening consisting of a review of their driving records, a criminal records check, and prior employment references checks; and then to one of the popular screening tests, such as the Seattle video. The applicants remaining after the screening test will typically go through the personal interview process and a practical fit exam to assess whether the applicant can comfortably fit into the driver workstation and operate all of the bus controls and equipment in a proficient manner. APTA has arranged for the development of BOSS, which is a more comprehensive screening process.

Sources or References

The BOSS program is more than a simple screening test; it consists of a written assessment and a structured personal interview, which are collectively designed to predict the safety, attendance, and customer service performance of bus operator applicants. The BOSS program is becoming increasingly popular in the transit industry, with 23 transit properties using it to screen more than 12,600 candidates as of Spring 1997. Some transit properties interviewed expressed some concern regarding the cost.

The Seattle video is a video-based screening test, entitled "Working With the Public." The copyrighted test is intended to identify applicants with good human relations skills on the basis of their response to a series of difficult situations with a passenger, such as refusal to pay fare, improper boarding or alighting, or unruly behavior. The Washington State Transit Insurance Pool Loss Control Manual suggests that each transit system validate the test before use and that each system evaluate the applicability of Equal Employment Opportunity Commission guidelines to the test.

Metro Transit (Seattle) has continued to use the "Working With the Public" video test for many years. In 1993, Metro Transit raised the passing score on this test from 182 to 200. This increase in standards has proven to be very successful in screening out candidates who may have the requisite mechanical skills to operate the bus, but who eventually leave Metro Transit because they do not have the people skills that are essential to the job. Please refer to the Metro Transit safety practices profile in Chapter 2 for a complete description of its successful practices for finding and hiring bus operators, including the use of the video screening test.

The original developers of the Seattle video (ERGOMETRICS of Seattle, Washington) have recently announced the availability of new video-based tests for hiring fixed-route and paratransit operators. The new tests, known as START People Sense™ (People Sense), were developed in conjunction with 20 transit agencies (18 in the state of Washington and one each in Anchorage, Alaska, and Vancouver, British Columbia, Canada). The updated content of People Sense includes relations with customers, supervisors, and coworkers and working with a diverse customer base, including teenagers and paratransit customers. START Driving is a video and animation-based test of driving judgement that simulates the multitasking environment of operating a transit vehicle.

The Regional Transportation Commission (Reno, Nevada) uses the "Driver's Risk Index" video: a 50-question test with simulations to present a driving situation where the candidate has to react and pick one out of two choices within a few seconds.

Evaluation of Effectiveness

Developers of BOSS (SHL Landy, Jacobs, Inc.) have prepared an evaluation that suggests that BOSS's use will lead to savings in accident costs that far outweigh the cost of administering the test. They have computed a reduction of 38 accidents per year for each 100 bus operators that are hired when using the BOSS selection process.

The evaluation of the BOSS Program at NJ Transit indicated that the collision accident rate for BOSS-selected operators was actually slightly higher (2.63 accidents per FTE, or 2,000 operator hours) versus the rate for pre-BOSS operators (2.39 accidents per FTE).

No evaluation has been conducted on the other screening tests.

Transit System or Other Contacts

BOSS
Rick Jacobs
SHL Landy, Jacobs, Inc.
(814) 237-5997

Seattle Video
Metro Transit
Maureen McLafferty
Human Resources Section
(206) 684-6788

START Testing™
ERGOMETRICS
Carla Swander
(206) 526-9655

Driver's Risk Index Video
RTC/Citifare-Reno
Jim Wunder
(702) 348-0400

DRIVER TRAINING

Defensive Driving Training

Summary Description

The defensive driving course (DDC) is the cornerstone of all accident prevention practices involving performance of the bus operator. Transit systems have identified the DDC as the most effective accident prevention practice. The principles of defensive driving are well established, and a wide variety of different training methods and approaches are available. Some of the most popular DDCs are described below.

Sources or References

The NSC DDC for transit (Coaching the Transit Bus Driver) is used by many transit systems as a base and then modified over time to add information that is directly relevant to the transit systems' own operations.

Several transit systems reported using the TSI bus operator training materials on defensive driving as a base for their in-house training programs.

The Smith System® is the most popular of the defensive driving programs offered by private companies. This system emphasizes a small class size (five people or fewer) and hands-on, on-the-road learning in the actual driving environment.

Professional Development Associates (PDA) offers a computer-based, interactive version of the NSC 8-h DDC. Each employee can learn at his or her own pace, and progress is automatically recorded.

Tri-Met (Portland, Oregon) developed a defensive driving workshop (DDW) in 1991. The 2-day DDW is a mix of classroom and behind-the-wheel instruction using the Smith System®, which is primarily for retraining bus operators who incur a first or second preventable accident. The DDW also provides all bus operators with advanced safety training.

Pierce Transit (Tacoma, Washington) has been providing a 1-day "New Hire Refresher Course" (NHRC) to its bus operators who have been on the job for about 1 year. Subjects covered in the course include common accident types and avoidance techniques.

Evaluation of Effectiveness

No evaluation is available for either the NSC or TSI DDCs, other than anecdotal data, such as "system's accident rate is one-half of the state average" and "accident rates for new drivers are generally low."

Tri-Met was one of the few transit systems identified in Phase I of this project that had actually conducted a quantitative evaluation of an accident prevention practice. Tri-Met conducted an evaluation of their DDW in 1995. The evaluation compared the performance of nearly 700 operators over a 24-month period before and after taking the DDW. The number of preventable accidents among operators who took the course decreased by about 45 percent, while total accidents decreased by about 22 percent.

Tri-Met agreed to collect data for an updated evaluation of the DDW. The sample of operators was restricted so as not to overlap with the 1995 evaluation. The results of the 1999 evaluation confirmed the earlier 1995 evaluation results. For a sample of 160 bus operators qualified for the 24-month before-and-after evaluation, the measured reduction in preventable accidents was approximately 65 percent, while the total accidents decreased by approximately 37 percent.

The evaluation of the NHRC at Pierce Transit, comparing the accident rate of NHRC participants for 2 years immediately following the course with that of pre-NHRC operators using a comparable 2-year evaluation period, showed virtually no difference in the rate of preventable accidents. However, operators taking the NHRC had a lower rate of nonpreventable accidents.

Red Rose Transit Authority (RRTA) in Lancaster, Pennsylvania, began use of the PDA computer-based Defensive Driving Course–Personal Computer (DDC-PC) in 1995. Initially used as a refresher training program, DDC-PC is now part of the training for new drivers. The number of preventable accidents declined from 48 in 1994 to 37 in 1995 (first year of use) and 27 in 1996, achieving the best accident safety record since 1983. Recent performance reversed the accident trend (24 preventable accidents in a 6-month period), causing RRTA to consider using the program as a refresher for all operators.

Transit System or Other Contacts

RRTA
David W. Kilmer
(717) 397-5613

Tri-Met
Adrian Moy
(503) 238-4854

Pierce Transit
Clint Wetzel
(253) 581-8024

NSC
National Safety Council
(800) 621-7619

Smith System
Del Lisk
(800) 777-6741

PDA
Professional Development Associates
(810) 737-9600

Driver Training Simulators

Summary Description

The driver training simulator has training stations that are a real-world mock-up of driving controls, instruments, and seating of a typical bus. The simulator system projects views of traffic situations, and a computer controls the display and monitors the individual's response to a particular situation. The simulator can be used to check hand-eye coordination, reaction times, and general driving skills of drivers. It is also used to reinforce proper driving habits and defensive driving principles for driver refresher training.

The driver training simulator is not used extensively in the transit industry; only about 15 percent of respondents reported using it. Simulators are used most often at the larger transit systems because of cost considerations. The major manufacturer of bus simulators is Doron Precision Systems of Binghamton, New York. The transit agencies using Doron bus simulators include Greater Cleveland Regional Transit Authority (GCRTA) in Cleveland, Ohio; Greater Hartford Transit District in Connecticut; Tidewater Regional Transit in Norfolk, Virginia; OCTA in California; Southeastern Pennsylvania Transportation Authority (SEPTA) in Philadelphia, Pennsylvania; and Greater Richmond Transit Company, Virginia.

FAAC, Inc., of Ann Arbor, Michigan, offers fully interactive vehicle driving simulators to commercial and military clients, featuring a 180-degree panoramic view of the road created with computer-generated imagery on three large graphic displays. FAAC, Inc., has fielded 32 driving simulators worldwide to date.

FAAC has recently been awarded a contract by New York City Transit to build a bus simulator using a full-size New Flyer bus cab as the driving station. The system was shown for the first time at the APTA Expo 99 (October 11–13, 1999) in Orlando, Florida.

Sources or References

NJ Transit has made extensive use of driver training simulators. It has both a four-station and an eight-station simulator system, in addition to an interactive vehicle-maneuvering trainer (VMT). The VMT station controls the maneuvering of a $\frac{1}{16}$-scale model maneuverable bus, equipped with television cameras, as the bus travels around a scaled mock-up of streets, intersections, railroad crossings, people, buses, and cars. The VMT can be set up to simulate an accident-related traffic situation so that instructors can observe unsafe driving behavior and teach trainees the correct use of defensive driving techniques.

The Greater Hartford Transit District has established the Driver Improvement Center, which offers comprehensive driver training programs for bus, car, and van fleet operators. This center uses a driver training simulator as the central focus of a 6-h defensive driving techniques course, which includes a driver perceptual test, lecture, discussion, video, and a simulation.

Evaluation of Effectiveness

No evaluation of the effectiveness of driver training simulators on reducing bus accidents has been found.

Transit System or Other Contacts

Greater Hartford
Ken Goldberg
(860) 247-5329 x3003

NJ Transit
Dale Sulpy
(978) 378-6868

Driver Simulators
Doron Precision Systems, Inc.
(607) 772-1610

Driver Training (DTS™)
FAAC, Inc.
(734) 761-5836

SAFE DRIVER INCENTIVES

Safety Awards and Other Recognition

Summary Description

Most transit systems have a safety awards or recognition program that provides a graduated series of awards in the form of patches, pins, belts, buckles, and so forth for increasing periods without a preventable accident. The NSC promotes this approach with its Safe Driving Awards Program. The bus roadeo is an integral part of the safety awards or recognition practice, with bus drivers competing against each other to demonstrate their driving skills in simulated transit-operating situations. Such roadeos can range from the local level up through regional and statewide competitions, ultimately leading to participation in the Annual APTA International Bus Operator's Roadeo—a prestigious event that involves more than 100 of the best drivers in the United States and Canada.

APTA's new policy only allows member transit systems to participate in its annual roadeo. As a result, many small and medium-sized transit agencies that have not joined APTA are not eligible to participate in this national competition.

Sources or References

There are many different types of safety awards or recognition programs; therefore, it is difficult to select one or two to represent the industry. One example of a transit system that has spent considerable effort and resources to provide public recognition of safe driving skills is Houston Metro. A Houston Metro bus driver won APTA's International Bus Operator's Roadeo in 1996, and, as a result, he was rewarded with substantial local and national media exposure, including major network news coverage and a page on Houston Metro's Internet site illustrating his accomplishments. Houston Metro then presented him with his own bus—wrapped in a larger-than-life likeness of the driver, with a banner reading "America's #1 Bus Operator thanks you for riding Metro." Any patrons boarding the bus, which the top-ranked operator took onto different routes throughout Houston, rode for free until the next International Bus Operator's Roadeo.

The safety practice profiles in Chapter 2 contain detailed descriptions of the safety awards or recognition programs used by the exemplary safety performance transit agencies.

Evaluation of Effectiveness

No evaluation of the effectiveness of safety awards or recognition programs in reducing bus accidents was found.

Transit System or Other Contacts

NSC
(800) 621-7619

Houston Metro
Oliver Bellard
(713) 615-6671

Note: *TCRP Synthesis 18*, "Bus Occupant Safety," provides detailed examples of safe driving award programs from three different transit systems.

Bonuses and Other Prizes

Summary Description

A number of transit systems offer cash bonuses or valuable prizes as part of their safe driver incentive programs. These programs are typically tied directly to the period of time operated without a preventable accident.

Sources or References

Examples of some typical safe driving bonus programs include the following.

- Central Contra Costa Transit Authority (County Connection) in California provides annual bonuses for zero preventable accidents, with the bonus amount proportional to total wages.
- LYNX (Orlando, Florida) has a bonus program where zero preventable accidents rewards the driver with $240 plus $10 for each year of service.
- People Mover (Anchorage, Alaska) awards a bonus of several thousand dollars for the citywide employee of the year competition.
- MARTA's full-time bus operators are eligible to receive a quarterly safety bonus of $30 if they attend two safety meetings and have no preventable accidents during the quarter. Operators receiving three consecutive bonuses are eligible for a $100 premium bonus as a fourth award, amounting to a total of $190 for any single year (see MARTA safety practice profile in Chapter 2).

Evaluation of Effectiveness

No evaluation of the effectiveness of bonuses or other prizes in reducing bus accidents has been located.

Transit System or Other Contacts

County Connection
Sharon Porter
(510) 676-1976

LYNX
Mike Miskow
(407) 841-2279 x3563

People Mover
Robert Miller
(907) 343-8171

MARTA
Larry Engleman
(404) 848-5233

CUSTOMER SAFETY

Passenger Training

Summary Description

The typical passenger training program involves an instructor and a bus sent to a specific location where there is a concentration of active bus riders (such as a senior housing center) or potential riders. The program generally involves such activities as teaching the proper use of wheelchair lifts, fare payments, trip planning, routes and stops, and special care to be taken when there are wet and slippery conditions. Most of these programs are intended for showing people with physical and other disabilities the proper and safe procedures for boarding, alighting, and riding on the bus. There are also training programs that are intended to assist people with English language difficulty in learning about the use of the transit system.

Sources or References

The following are a few of the transit systems that rated their passenger training program as highly effective.

- Akron Metro in Ohio. The customer service department teaches people with English language difficulties how to use the local transportation system by going with them on a trip and making sure they know every step in the trip-making process.
- Capital District Transportation Authority (CDTA) in Albany, New York. CDTA provides an instructor and bus to go to senior centers and worksites to show people with disabilities how to safely ride. CDTA checks routes, stops, and policies for customers.
- County Connection (California). County Connection is currently working with the California Transit Insurance Pool to prepare a passenger guidelines document to educate passengers about the safe use of transit services.

Evaluation of Effectiveness

No evaluation of the effectiveness of passenger training programs in reducing bus accidents has been located.

Transit System or Other Contacts

Akron Metro Kent Weston (330) 762-7267 x3105	CDTA Jim Boudreau (518) 482-7286	County Connection Sharon Porter (510) 676-1976

Education for School Children

Summary Description

Educational programs for school children are frequently used by transit systems, but they are only considered to be moderately effective in reducing accidents. These programs typically involve taking the bus to school facilities where the instructor can teach the safe use of the bus, including safe behavior after leaving the bus and crossing a street or highway. Sometimes the school children are brought to the transit system's operations and administration facilities. There appears to be a substantial number of systems that place the focus of their training on grades 4–6, rather than have broad-based training covering K–12.

Sources or References

There are a broad variety of educational programs for school children. Some representative examples of these programs include the following.

- City Utilities of Springfield (CUTS) in Missouri. A bus operator (who leads the session) and supervisor travel to elementary schools to talk about safe riding on CUTS buses, using coloring books with a safety emphasis as part of their message.
- Akron Metro has established a "Cool Rider" program with a "Tony the Tiger" mascot. This program teaches K–6 school children how to ride Metro.
- Toledo Area Regional Transit Authority (TARTA) in Ohio shares a program called "Safety Town" with the police department. This program provides school children with broad-based safety instructions.
- NJ Transit operates a school visit program, focused on grades 4–6, under the direction of the customer service department. It also provides a transit facility site visit program that can accommodate large groups of students (200+).
- DTA (Minnesota) has developed a student safety program entitled "Operation Bus Ride" because student riders constitute a major portion (4,000 trips per day) of DTA's patrons. The program includes a bus puppet show for third graders, a series of classroom safety posters, and specialized training for DTA bus operators in how to handle problems with student riders. See the DTA safety practices profile in Chapter 2.

Evaluation of Effectiveness

No evaluation of the effectiveness of educational programs for school children in preventing accidents has been found.

Transit System or Other Contacts

Akron Metro Kent Weston (330) 762-7267 x3105	NJ Transit Dale Sulpy (978) 378-6868	CUTS Carol Cruise (417) 831-8784
TARTA John Stewart (419) 245-5235	DTA Tom Szukis (218) 722-4426 x308	

Note: *TCRP Synthesis of Transit Practice 18*, "Bus Occupant Safety," provides examples of transit safety educational materials for school children from Dallas, Riverside (California), and Long Beach (California).

MANAGEMENT

Vehicle Safety Inspections

Summary Description

The vehicle safety inspection is a standard practice in the transit industry. It is also the third most highly rated accident prevention practice. The typical practice is to allow the bus operator 10 min paid time to conduct a pre-trip safety inspection using a checklist, which includes a number of safety-

related parts and items to be inspected. Some transit systems use both pretrip and post-trip inspections. Vehicle safety inspections are also part of the routine safety checks conducted at regular mileage or time intervals, typically 3,000–6,000 miles or 3 months, whichever comes first. Some smaller systems use their state safety inspection services.

Sources or References

Each transit system usually develops its own bus safety inspection forms and checklists on the basis of the vehicles they are operating and their own expertise and experience. For reference purposes, the California and Washington statewide transit insurance pools provide examples of inspection forms and checklists in their safety and loss control manuals. Most transit systems use a multipage form: one copy can be provided for maintenance, citing defects that were found, and the driver's copy is used for the actual checkoff of the list.

Evaluation of Effectiveness

No evaluation of the effectiveness of vehicle safety inspections in reducing bus accidents has been located.

Transit System or Other Contacts

California Transit
Insurance Pool (CalTIP)
System Safety Program Model
Edward Gerber
Joshua Shaw
(916) 446-4656

Washington State
Transit Insurance Pool
Loss Control Manual
Doug Bird
(360) 705-8294

Note: *TCRP Synthesis 18*, "Bus Occupant Safety," provides examples of pretrip inspection and defect report forms from three transit systems.

System Safety Programs

Summary Description

The concept of a system safety program for bus transit systems has been accepted at a large majority of the respondent transit systems and is considered to be quite effective in preventing accidents. The system safety program (SSP) is the process of ensuring that safety is integrated into all aspects of transit system operations. The key features of the SSP include the full commitment and support of top management to system safety; the inclusion of all departments in the process; the designation of one individual (with direct access to top management) as the responsible safety authority; the identification and definition of the safety roles and responsibilities of all departments and key individuals; and the establishment of a proactive safety program, with emphasis on identifying and resolving hazards prior to their causing accidents.

Sources of References

The SSP is documented in a plan. A number of transit systems have developed their plans in accordance with guidance from such sources as FTA reports, including *Bus and Passenger Accident Prevention*, system safety training courses offered by TSI in Oklahoma City, safety manuals produced by the statewide insurance pools (e.g., the CalTIP System Safety Program Model), and state safety oversight agencies (e.g., New York State Public Transportation Safety Board).

Some of the transit systems contacted indicated that they had comprehensive system safety program plans (SSPPs). Those systems, which include NJ Transit, Valley Transit (Appleton, Wisconsin), Los Angeles County Metropolitan Transportation Authority (MTA), and Votran (Daytona, Florida), may be able to provide information about their plans, which can be helpful in developing or improving an existing plan.

Each of the exemplary safety performance transit systems profiled in Chapter 2 has an SSPP. The "Management Approach to System Safety" sections of the profiles for RTD (Denver) and Metro Transit (Seattle) provide further details on different approaches to the development and management of an SSP.

Evaluation of Effectiveness

The effectiveness of an SSP in reducing bus accidents cannot be evaluated because an SSP is an entire process comprising many different safety activities. There is no way to evaluate an SSP in quantitative terms.

Transit System or Other Contacts

Los Angeles County MTA,
Rufus Francis
(213) 922-4964

Valley Transit
Thad Kluck
(414) 832-6100

TSI
Mass Transit Division
(405) 954-3682

CalTIP
System Safety Program Model
Edward Gerber
Joshua Shaw
(916) 446-4656

NJ Transit
Dale Sulpy
(978) 378-6868

Votran
George Soloway
(904) 756-7496 x113

New York State Public
Transportation Safety
Board (PTSB)
John F. Guinan
(518) 457-6512

Reports

FTA Report No. M-26-0010-94-1, Byman, J. A. and Hathaway, W. T., *Bus and Passenger Accident Prevention* (June 1994).

Safety Audits

Summary Description

The purpose of a safety audit, in the context of an SSP, is to ensure that all parts of the transit organization are fulfilling their system safety responsibilities. There are two types of safety audits: an internal audit performed by a system safety department or a safety audit committee; and an external audit conducted by an insurance carrier, transit insurance pool, or a state safety oversight agency.

Sources or References

Some examples of safety audits reported by transit systems include the following.

- The Alameda–Contra Costa Transit (AC Transit) in Oakland, California. The safety department checks each bus every quarter and verifies that all defect write-ups and work orders have been completed.
- Beloit, Wisconsin. Transit Mutual Insurance Company of Wisconsin established a safety committee to perform an audit of this transit system's safety records, training programs, and accident reporting process and to conduct unannounced ride checks to monitor service quality.
- Laketran (Grand River, Ohio). Laketran hires an out-of-state contractor to conduct an independent audit of all parts of the operation, including safety.

As noted for Beloit, the Wisconsin pool (Transit Mutual Insurance Company of Wisconsin) has abandoned the contract audit approach and replaced it with a safety committee comprising representatives from a cross section of the participating transit systems. Using a six-page checklist developed by the safety committee, the committee audits each participating transit system at least once every other year. The audit protocol was enhanced to include field ride checks to detect any deviation from recommended coach operator practice. Committee members staff the audit, and their recommendations are advisory. Fortunately, the peer pressure associated with recommendations from other pool participants causes almost certain compliance.

Evaluation of Effectiveness

No evaluation of the effectiveness of safety audits in reducing bus accidents has been found.

Transit System or Other Contacts

AC Transit	Beloit	Laketran
David Peery	Robert Spenle	Andy Altenweg
(510) 891-4807	(608) 364-2870	(216) 350-1000

Safety Committee for Accident Review

Summary Description

The safety committee for accident review is responsible for determining the preventability of each bus accident. The makeup of the committee is very important, since operator incentives or possible disciplinary action will depend upon the committee's decision. In most cases, there is a provision for appealing an adverse decision (i.e., the accident was preventable). If the initial decision was made by a supervisor, safety officer, or some other individual, the first appeal would typically go to the committee. Some transit systems have provisions for appealing adverse decisions to outside safety agencies, such as the NSC.

Sources or References

There are many different approaches to the formation and operation of a safety committee for accident review. The following examples illustrate the wide range of approaches.

- Community Transit (Snohomish County, Washington). Washington State Administrative Code mandates the use of a safety committee. The committee includes 10–12 people from management, operations, and administration. Accident review is based on NSC guidelines, with the risk manager making the initial decision and any appeal going to the safety committee. A second appeal would go to the NSC. The committee is also responsible for review and educational activities leading to "Lessons Learned."
- Connecticut Transit. Connecticut Transit uses one person to "grade" an accident according to standards. Its safety committee will look into the accident review process to check on fairness of grading and override the grade if the driver was not treated fairly.
- MARTA (Atlanta, Georgia). MARTA has recently reformulated its safety committee as a bus accident review board. There are three management representatives: the bus safety officer (chair), the bus training instructor, and a bus superintendent. The union selects two bus operators, along with two alternate names. The chair of the board conducts the meetings but only votes in the event of a tie. See the MARTA profile in Chapter 2, "Monitoring and Managing Bus Operator Safety Performance," for more details.
- Regional Transportation Commission (RTC) in Reno, Nevada. The accident review process starts with the RTC supervisor who responded to the accident, then to the

other bus operators, then to the Accident Review Committee, and finally to the Director of Operations. Appeals can be made to the General Manager. The front line supervisors and peers are close to the situation and base their reviews on direct knowledge and expertise, which is hard to contest.
- Metro Transit (Seattle). Metro Transit has one of the most thorough processes for determining preventability. This process has been documented as the "Preventable Accident Review System." The process also includes a determination of severity for each preventable accident. A complete description of the Metro Transit process, which represents a "best practices" model, can be found in Chapter 2.

Evaluation of Effectiveness

No evaluation of the effectiveness of a safety committee for accident review in reducing bus accidents has been found.

Transit System or Other Contacts

Community Transit Tom Glover (206) 348-7141	Connecticut Transit Michael Blondin (860) 522-8101	MARTA Larry Engleman (404) 848-5233
RTC Jim Wunder (702) 348-0400	Metro Transit Mike Wines (206) 684-2915	

Computerized Accident or Incident Database

Summary Description

A computerized accident or incident database is an essential safety management tool for all but the smallest transit systems (i.e., those that can maintain data files for a small number of accidents in a manual format). A well-designed accident database can be used to identify drivers who require additional training, the specific type of training that they may require, design or equipment problems with specific buses, and special roadway conditions that lead to a preponderance of accidents in a particular location.

A comprehensive database will allow the system to track all of the details of both accidents and incidents, including minor events (such as rocks or other missiles thrown at the bus) and safety-related maintenance events on the road. An accident and incident reporting system that uses the database should be able to provide information on accident characteristics, causal factors, injuries sustained, repairs required, type of bus, other vehicles involved, costs, driver involved, location, police involvement, and so forth. Trend analysis using the database would allow an agency to track very specific problems (e.g., which types of buses are more likely to be involved in side collisions, leading to a decision to retrofit special lights or mirrors to solve the problem).

Sources or References

The development of an accident or incident database depends on the specific requirements of each individual transit system and the nature of the other information systems maintained by other departments (e.g., human resources [driver data], training, and risk management or claims) because of the need to have a good informational interface among all systems. There are a number of transit agencies that have identified their own accident database and accident analysis systems as being highly effective in reducing accidents. An examination of the database structure and the use of the related reporting and trend analysis systems developed by these agencies may be useful to other transit systems.

- Mississauga Transit (Ontario) has developed a comprehensive accident or incident database that enables Mississauga Transit to track detailed information on all types of accidents and incidents, even minor ones.
- Muni (San Francisco) has been able to conduct some excellent published research and statistical analyses on bus collision accidents and passenger accidents aboard transit vehicles because of Muni's comprehensive accident or incident database.
- Pierce Transit (Tacoma, Washington) uses its accident database and reporting systems to track preventable accident performance against safety goals for different classes of service (shuttle, fixed route, express) and to analyze the most common types of vehicle collisions for those services.
- Metro Transit (Seattle) is able to monitor bus accident trends and operator safety performance very precisely because of its comprehensive online accident database and query system. Metro Transit's safety section routinely generates analysis reports of accidents by classification codes, location, route, work location, coach type, and fleet. See the Metro Transit profile ("Monitoring and Managing Bus Operator Safety Performance") in Chapter 2 for further details.

Evaluation of Effectiveness

The accident or incident database is an essential component in conducting a quantitative evaluation of the effectiveness of other practices, but it cannot be evaluated as a separate practice.

Transit System or Other Contacts

Mississauga Transit Maureen Perry (905) 615-3860	Muni Ron Hundenski (415) 923-6290

Metro Transit	Pierce Transit
Mike Wines	Steven Nunan
(206) 684-2915	(206) 581-8060

Programs for "Accident Repeater" Drivers

Summary Description

Programs for "accident repeater" drivers are designed to provide specialized assistance and refresher training to drivers who have an above average rate of accidents or who have more than a specified number of preventable accidents in a given period of time.

Sources or References

The programs for "accident repeater" drivers can take a wide variety of forms, as illustrated in the following.

- RTD (Denver). Operators involved in a preventable accident are subject to retraining using a point system that distinguishes between serious and minor accidents. Depending upon the points accumulated over a 12-month period, the disciplinary action involves a combination of training and days of unpaid suspension. See RTD's safety practices profile for more detailed information.
- Des Moines Metropolitan Transit Authority (Des Moines Metro) in Iowa. The program is targeted to help drivers who have specific operating problems, such as those who repeatedly damage mirrors upon pulling out of the garage or who cut too sharply when making turns. The driver is required to perform the problem maneuver over and over until achieving the necessary expertise.
- NJ Transit has a special program for its part-time operators. Statistical data on the accident rates for the part-time operators showed a significant increase for the time period at 19–21 months following initial training. It now provides 1-day refresher training at the 15–18 month time period, followed by a ride check at 90 days after the refresher training.
- Pierce Transit uses a graduated program for accident repeaters, with increased training and remedial actions provided in response to a higher number of accidents within a 2-year period.
- MARTA (Atlanta) conducts refresher training for operators who have had either one or two preventable accidents within a 24-month period. Operators with three preventable accidents within 24 months are subject to discharge. The retraining includes at least 2 h of on-road defensive driving training, with a visit to the accident scene during this driving period. See MARTA's safety practices profile in Chapter 2 for further details.
- Metro Transit (Seattle) provides retraining for individual operators whose accident record indicates that such action is required. Retraining involves one operator per transit instructor over 3 days, 8 h each day. The standardized format includes open discussion, videotapes, review of safe driving skills, coach practice, and an 8-h driving assignment. See Metro Transit's profile on training and refresher training for further details.

Evaluation of Effectiveness

NJ Transit reports that the accident rate for the group of part-time operators with 19–21 months of driving experience has dropped since the refresher training and ride check program was initiated. There was no documentation available regarding the overall accident rate reduction.

Pierce Transit analyzed its prior accident rates and trends and found that 25 percent of the workforce with less than 18 months of experience was having about 36 percent of the accidents. Its group "accident repeater" program has resulted in an improvement in the accident rate; however, no documentation or data are available.

The evaluations conducted for Tri-Met's DDW and Pierce Transit's NHRC (see the "Driver Training" section in this chapter) are also applicable to this practice. The evaluation of the DDW indicates that the DDW is highly effective in reducing the preventable accident rate of operators for at least 2 years following DDW training.

Transit System or Other Contacts

RTD	Metro Transit	Des Moines Metro
Alice Osner	George Criddle	Donna Grange
(303) 299-6071	(206) 684-2823	(515) 283-8127
NJ Transit	Pierce Transit	
Dale Sulpy	Steven Nunan	
(978) 378-6868	(206) 581-8060	

Ride Checks

Summary Description

A ride check simply means that the bus operator's driving performance and interaction with passengers is monitored by an observer sitting on the bus or in a vehicle following the bus over its route.

Ride checks can be either announced or undercover, depending upon the circumstances. The ride check can identify safety problems, such as improper operator driving behavior, possible schedule problems, and possible route traffic problems. There are at least three basic reasons for transit systems to conduct ride checks.

- The ride check is mandated on the basis of the operator's record of preventable accidents or other evidence of driving problems.
- The ride check is a standard procedure (one element of a safety audit) that is used to ensure the safety and quality of transit services being provided.

- The ride check is used as part of the initial training process for new operators, using either other experienced operators or supervisors to provide guidance on a routine basis.

Sources or References

There is no particular structured format for a ride check. The general guidance from the Washington State Transit Insurance Pool Loss Control Manual summarizes the key features of bus operator monitoring using ride checks. These features include performance of the ride checks during revenue service operation, conduct of the ride checks by the bus operator supervisors in order to allow for immediate corrective action for any observed problems, the use of a checklist (the Washington State Transit Insurance Pool provides a sample ride check format) to ensure that all ride checks are performed in a comprehensive and effective manner, and provision for continuous monitoring of newly hired operators to assess performance and frequent monitoring of more experienced operators (e.g., on a regular 3–6 month cycle). CalTIP guidelines for operator performance evaluation are more extensive, but they cover the same basic ideas.

Each of the exemplary safety performance transit systems profiled in Chapter 2 conduct some form of ride checks to help monitor and manage bus operator safety performance. Metro Transit (Seattle) has the most structured and comprehensive approach, which is presented in a nine-page document, "Standards for Performing Ride Checks." Refer to Chapter 2 for further details.

Evaluation of Effectiveness

No evaluation of the effectiveness of ride checks in reducing bus accidents has been located.

Transit System or Other Contacts

CalTIP
System Safety
Program Model
Edward Gerber
Joshua Shaw
(916) 446-4656

Metro Transit
Mike Wines
(206) 684-2915

Washington State
Transit Insurance Pool
Loss Control Manual
Doug Bird
(360) 705-8294

Questionable or False Claims Programs

Summary Description

Transit systems designed questionable or false claims programs to address the problem of questionable or false claims of injury by passengers or by people who claim to be passengers in the aftermath of a transit bus collision accident. Many false claims are associated with a slip, trip, or fall while a passenger is entering, traveling on, or exiting from a bus that results in an injury. This practice is quantitatively different in that it does not result in a reduction in the actual number of accidents and injuries; it actually helps to ensure that the reported number is as close as possible to the true number of collision injuries and personal injury accidents. Transit systems of all sizes tend to use questionable or false claims programs to a limited extent (approximately 30 percent use); however, the larger transit systems find them to be most effective.

Sources or References

The transit systems that rated the questionable or false claims program as highly effective indicated that they had set up their own procedures for investigating all claims and that it required management vigilance to be on the alert for patterns of fraudulent activity.

- County Connection (California) reported that CalTIP was very helpful in providing information that could be used to identify "repeaters" (particular riders) who were responsible for filing numerous false claims.
- SEPTA (Philadelphia), while not directly contacted as part of this study, has developed one of the most effective questionable or false claims programs in the industry. It has achieved very substantial reductions in the number of claims and claims payments through aggressive handling of claims (i.e., not settling, but resolving matters through the courts) and through the use of onboard digital video surveillance systems on many high-claims bus routes.

Evaluation of Effectiveness

There were no specific evaluation data available from the systems interviewed as part of this study. SEPTA has produced statistics on the reductions in claims due to its aggressive claims handling, and it is currently evaluating the impact of the full-scale installation of digital video surveillance systems on high-claims bus routes.

Transit System or Other Contacts

County Connection
Sharon Porter
(510) 676-1976

SEPTA
Eileen Katz
(215) 580-7445

BUS TECHNOLOGY

Driver Vision and Mirrors

Summary Description

Safety improvements in the area of driver vision and mirrors are intended to give the driver a better view of the door areas and the wheelwell areas. Transit systems are working

with a number of mirror types and configurations to achieve this goal of improved safety through better driver vision.

Sources or References

The following transit systems have reported highly effective safety improvements in driver vision and mirrors on buses.

- Clallam Transit (Washington) installed remote-controlled, heated mirrors 6 years ago and believes that the mirrors have been highly effective in preventing accidents.
- Houston Metro is equipping all of its buses with separate convex mirrors on both sides, mounted under the standard mirrors; this program started in the early '90s.
- Metro Transit (Seattle) uses remote-controlled flat mirrors and separate convex mirrors.
- Metropolitan Transit Authority–Long Island (MTA-LI) Bus believes that the proper use of mirrors is the key to safe driving and emphasizes it as part of its DDC (Smith System).
- NJ Transit includes in its specifications a full-size convex mirror for the right side (curb) so the driver can see the right rear tire when making the turn; this program is in response to a significant increase in accidents associated with wider buses (102 in. versus 96 in.), including mirror hits, pull-out accidents, and right-turn side swipes.
- TARTA (Toledo, Ohio) has installed a separate convex mirror on the right (i.e., curb) side to provide a better view and assurance that school children (a significant portion of the rider base) are clear of bus before proceeding.
- Worcester Regional Transit Authority (RTA) in Massachusetts has had electronic remote-controlled heated convex mirrors since 1995.

Evaluation of Effectiveness

Despite the fact that many transit systems are using advanced mirror types and configurations, none of them had conducted any evaluation of their effectiveness in preventing specific types of accidents. The planned evaluations to be conducted as part of this study could not be completed because the participating transit systems were unable to provide sufficiently detailed data in an electronic format.

Transit System or Other Contacts

Clallam Transit
Dave Fox
(360) 417-1361

Houston Metro
Oliver Ballard
(713) 615-6671

Metro Transit
Mike Wines
(206) 684-9215

MTA-LI Bus
Margaret Connelly
(516) 542-0100 x4512

NJ Transit
Dale Sulpy
(978) 378-6868

TARTA
John Stewart
(419) 245-5235

Worcester RTA
Bob Jeniski
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Brake Lights and Other Warning Signs

Summary Description

There are two major areas of safety improvements in brake lights and warning signs. The first improvement is the use of LEDs as replacements for conventional rear brake and turn signal incandescent bulbs. LED lights are much easier to see in bright sunlight because of their brightness and luminosity. They also light up more quickly than do incandescent bulbs, providing a slight advantage in stopping distance (approximately 8 ft at 30 mph). The second area of improvement is in the use of an additional brake light(s) in the form of a high-mounted center brake light ("cyclops"), two high-mounted lights at the top rear corners of the bus, and various combinations of those lights. Other safety improvements cited by one or more transit systems included using strobe lights and changing the paint color at the rear of the bus.

Sources or References

The following transit systems have reported their particular brake lights and warning sign improvements as being highly effective in preventing bus accidents.

- Anchorage Transit (Alaska) has been using both strobe lights and flashers in the back since 1986.
- BC Transit (Victoria) is converting its fleet to LED lights to increase visibility in bright daylight and to provide additional stopping distance to avoid rear end contacts.
- Ames Transit (Iowa) has installed LED lights since 1990, including three turn lights at each side on the rear of the bus, and found that there was a mitigating effect on the number of accidents.
- DTA (Duluth, Minnesota) has installed amber flashing lights that are connected to the rear door interlock since most passengers exit at the rear.
- Houston Metro is experimenting with two additional red flashing brake lights (round "truck" types) mounted high and near the center of the rear on approximately 25 buses. Metro has no apparent legal or regulatory problem with red flashing lights—unlike some states where these lights are allowed only on school buses and emergency vehicles.
- Metro Transit (Seattle) has specified LED brake lights for its order of 280 new Gillig buses.

- Link (Wenatchee, Washington) installed strobe lights at front and rear in 1996 and planned to report on their performance to the state in 1997.
- MARTA (Atlanta, Georgia) has 15–20 buses equipped with large 8-in. center brake lights (some are amber) that flash when the bus is braking. MARTA has not made a formal evaluation, but there have been very few of these specially equipped buses involved in rear end accidents. MARTA also has one bus with amber lights in upper corners, which MARTA believes will be very effective.
- Pierce Transit (Tacoma) experimented with different configurations before selecting a system with a high-mounted center red light with two amber lights, one on each side of the red light. The red is on steady and the yellow lights flash alternately when the brake pedal is depressed. This combination of lights has demonstrated very good results in reducing rear end accidents. Pierce Transit has also had success in reducing accidents using a warning sign (red on yellow) placed on the left rear corner of buses advising motorists of a relatively new state law requiring traffic to "yield to buses" that are pulling out from a stop.
- Utica Transit Authority (UTA) in New York changed the color at the rear of its buses from white to blue at the suggestion of its maintenance department. Since starting the practice in 1995, UTA has had no rear end collision accidents.

Evaluation of Effectiveness

The research team selected three different improvements in brake lights and warning signs as technologies to be evaluated for their effectiveness in reducing accidents where another vehicle collides into the rear of the bus. The transit agencies and technologies selected for evaluation include

- Pierce Transit's improved rear light warning system,
- Metro Transit's high-luminosity LED brake lights, and
- DTA's high-mounted, flashing amber lights.

The results at Pierce Transit showed that buses equipped with the improved warning lights (a red cyclops light at the rear center of the bus with amber flashing lights on either side) had a "vehicle into bus" accident rate that was approximately 25 percent lower than those same buses without warning lights.

At Metro Transit, buses equipped with the high-luminosity LED brake lights have a "Metro vehicle rear ended" accident rate that is approximately 40 percent lower than the rate for buses with conventional brake lights.

At DTA, the presence of a "passenger protection system"—a set of four high-mounted, flashing amber lights automatically activated when the rear door of the bus is opened—had no discernible effect on the rate of "rear ended in bus stop" accidents. In part, this lack of effect is due to the very low rate of such accidents, which occur only about once per year (or about 2 million bus miles).

Transit System or Other Contacts

Anchorage Transit
Robert Miller
(907) 343-8171

Ames Transit
Bob Bourne
(515) 296-4603

Houston Metro
Oliver Bellard
(713) 615-6671

Link
Don Butts
(509) 662-7458

Pierce Transit
Clint Wetzel
(206) 581-8024

BC Transit
Terry Beatson
(250) 385-2551

DTA
Tom Szukis
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Metro Transit
Mike Wines
(206) 684-9215

MARTA
Homer Clemmons
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UTA
Patricia Milazzo
(315) 797-1121

Doors and Door Controls

Summary Description

Most door and door control safety improvements focused on providing drivers with control (or more control) over the rear exit door so that the drivers could be more aware of passenger activity at the rear door. Several transit systems noted that the standard rear door interlock, which prevents the bus from moving when the rear exit door is open, is a highly effective safety feature.

Sources or References

Some of the specific door control safety improvements that were cited by transit systems include the following.

- Marqtran (Marquette, Michigan) has purchased pinch-point kits to eliminate all pinch points on each bus in its fleet. The kits provide spacers around pinch points, such as hand railings. This action was in response to an incident in which a passenger was caught in a pinch point and dragged along by the bus.
- OCTA (California) has installed sensitive edges on all doors. The doors will not close unless the driver enables them.
- Votran (Daytona, Florida) has added switches to provide for driver control of the rear exit door.

Evaluation of Effectiveness

No evaluation of the effectiveness of door and door control improvements on reducing bus accidents was found. The New York State (NYS) PTSB investigates all accidents caused by mechanical failure, including door interlock failures. The staff of the PTSB has produced special reports on door control problems and solutions.

Transit System or Other Contacts

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OCTA
Iain Fairweather
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Votran
George Soloway
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NYS Public Transportation Safety Board
John Guinan
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Lighting

Summary Description

Safety improvements in the area of lighting include better illumination of the stepwell area for passenger boarding and alighting and special side lights that help the driver to see the wheelwell area of the bus when maneuvering in poor light or nighttime conditions.

Sources or References

Some of the specific lighting safety improvements include the following.

- Knoxville Transportation Authority (Tennessee) has equipped its vehicles with dome lights at the entrances to ensure that the stepwells are well illuminated. It claims a low incidence of passenger injuries that could be attributed to inadequate lighting.
- NJ Transit has started a new "right-turn light" program. When the operator depresses the turn signal switch, two lights are turned on—one illuminating the area near the front wheel and the other illuminating the area near the rear wheel. The lights also turn on whenever a door is open and remain on for 6–7 s after the door closes. These lights provide the operator with better vision when making a turn and help the passengers see when boarding or alighting at night or low-light conditions.
- SamTrans (San Mateo County, California) installed two "pivot-point reference lights" on all of its buses starting in 1989. These lights illuminate the area forward of the rear wheelwells, helping the driver to see the rear wheels at night or in low-light conditions.

Evaluation of Effectiveness

No evaluation of the effectiveness of any special lighting improvements was found.

Transit System or Other Contacts

Knoxville
Greg Robinson
(423) 546-3752

NJ Transit
Dale Sulpy
(978) 378-6868

SamTrans
Elias Mosqueda
(415) 508-6258

Driver Workstations

Summary Description

The driver workstation (DW) involves the specific design features of the driver's seat and the location and placement of all controls and displays. Most transit systems have developed a complete set of specifications for the DW over a period of years, usually with substantial input from the bus operators who have to drive for long periods of time while avoiding accidents and any type of occupational injury. The goal of each transit system is to have a uniform DW design, regardless of the specific bus manufacturer and model that may be purchased.

A TCRP project on improving the DW has been completed at the Pennsylvania Transportation Institute (PTI). The project report (*TCRP Report 25*, "Bus Operator Workstation Evaluation and Design Guidelines") provides scientifically validated design guidelines that ergonomically accommodate operators from the 5th percentile female to the 95th percentile male population. The design guidelines address all aspects of the DW, including the seat, steering assembly, pedals, instrument panels, farebox, and other equipment.

Sources or References

The following transit systems provided some specific information regarding their work on improving the DW.

- BC Transit (Victoria) provided a complete description of its DW, including the layout of the driver's work area and controls. BC Transit also provided design information about a seat-related safety feature (alarm) that would help to prevent a bus rollaway.
- Santa Cruz Metropolitan Transit District (MTD) in California made a decision several years ago to retrofit all of its buses with a specially designed driver's seat, which has proven to reduce various job-related back injuries.
- Valley Transit (Appleton, Wisconsin) got its drivers involved with seat selection and ergonomics of the DW layout for its new buses. Valley Transit even borrowed some new buses to let the operators try out some new DW designs.

Evaluation of Effectiveness

PTI has estimated that workstation improvements identified in the design guidelines would increase the price of a standard transit bus by approximately $6,000, with a payback period of 3.5–8 years associated with estimated reductions in bus operator injuries. Indirect cost savings, such as the need for fewer replacement operators, would further reduce this payback period.

Transit System or Other Contacts

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Santa Cruz MTD
Michael Mawson
(408) 425-8951

Valley Transit
Thad Kluck
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Deceleration Alert Systems

Summary Description

When a bus decelerates, deceleration alert systems (DASes) signal the vehicles behind the bus by turning from green to amber, thereby providing advance warning of a possible braking action by the bus driver. DASes were reportedly in use at approximately 35 percent of the transit systems. While the comments about DASes were all generally favorable, there was one instance of a complaint caused by a driver who would accelerate and decelerate erratically. The drivers behind the bus were confused or concerned by the DAS light shifting back and forth between amber and green. This complaint against DASes can be converted into a positive attribute by considering that a supervisor following the bus would be able to quickly determine an erratic driving behavior or poor acceleration control simply by monitoring the DAS.

Sources or References

The following transit systems have rated DASes to be highly effective.

- Metro Transit (Minneapolis) has been using DASes since 1990 and has conducted an evaluation that demonstrated their effectiveness in reducing accidents (see the "Evaluation of Effectiveness" section that follows).
- Pacific Transit (Washington) has had DASes in place for more than 5 years and has received positive feedback from the community, with the exception of a complaint that one driver was accelerating and decelerating erratically, causing the DAS light to shift colors and confuse the following drivers.
- PTS (Phoenix) has been using DASes for 10 years and claims that the number of rear end collisions decreased (no quantitative data are available, since the changeover took place a long time ago).
- Tulsa Metropolitan Transit Authority (Oklahoma) has equipped its entire fleet with DASes. This change has lowered the rate of rear end collisions (no quantitative data are available).

Evaluation of Effectiveness

Minneapolis Metro Transit equipped a portion of its fleet with DASes in 1989. For calendar year 1990, it compared the number and rate of rear end collisions for DAS-equipped buses with those of a conventionally equipped bus fleet. The DAS-equipped fleet had an accident rate of 1.66 rear end collisions per million vehicle miles (based on approximately 10 million miles), and the control fleet had 3.26 rear end collisions per million vehicle miles. Therefore, the rear end collision accident rate was reduced by nearly 50 percent through the use of DASes.

Transit System or Other Contacts

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Pacific Transit
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PTS
Patsy Kelly
(602) 495-5571

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On-Board Surveillance Cameras

Summary Description

The use of on-board surveillance cameras is a relatively new technology practice involving multiple (two to four) CCTV cameras and a video image recorder to continuously monitor the interior of the bus and the doorway areas. The number and percentage of transit systems currently using on-board cameras and recorders (approximately 25 percent) is expected to increase dramatically because of current industry interest in the technology and anticipated benefits in terms of increased security.

On-board cameras are used primarily for security and for deterring unruly behavior and vandalism by school-age juveniles. The derivative benefits of the cameras and recorders include the ability to view incidents while passengers are on-board, entering, or exiting the bus in order to determine the physical circumstances in a personal injury accident. On-board surveillance cameras are a clear deterrent to fraudulent claims. CCTV may also be helpful in assisting investigators in determining the sequence of events in various types of collision accidents and the extent of any injuries to passengers resulting from the collision.

There are two methods that can be used for recording the images from on-board video cameras:

- Conventional videotape recording (i.e., analog) using a video cassette recorder (i.e., VCR) and
- Digital recording using a removable hard disk drive.

Originally, analog video (i.e., VCR) technology was utilized for on-board cameras. Some transit systems have reported that videotape recording technology requires a higher-than-expected maintenance commitment. Videotapes must be changed, monitored, and archived by either maintenance staff or security staff. Often, this effort proves to be too expensive or troublesome by agencies that have tried this technology. There have also been some problems reported in maintaining an accurate date and time stamp on the video images—a necessary feature if the video is to be used in court.

Recently, a number of transit systems have become interested in the use of digital recording technology, which promises to solve some of the maintenance and storage issues associated with VCR equipment. Utilizing digital technology, video image data are compressed using specialized software and then stored on a removable, shock-resistant hard disk drive. This system allows encryption of the data to prevent tampering or modification of the video images, making information collected in this manner more credible as legal evidence. The date and time features on the system are continuously recorded using an independent battery with a 5-year operational life. The system has the capability, with the proper software, to acquire data from the engine and vehicle electronic systems. It can capture up to nine variables, such as speed, door position, throttle position, and brake operation, thus operating as a "black box" event recorder for the transit vehicle, similar to those used on aircraft.

The principal disadvantages of digital systems are recording time and cost. Typical videotape recording times are about 72 h or longer using time-lapse VCRs, while digital systems have a maximum of approximately 24 h, with the storage capacity of the current disk drives being used. The manufacturers of digital systems expect the recording time to increase substantially as disk media become smaller and less expensive. Manufacturers of digital recorders also provide a means for the driver to capture a particular security incident or event and save it for review when the disk is removed and played back on a personal computer. The event will remain on the disk and not be overwritten, even if the disk remains in the recorder for more than 24 h.

The capital cost of a video surveillance system using a digital recorder is substantially more than the cost of a system based on a VCR. The operating and maintenance costs of the VCR-based system are expected to be higher because of the mechanical complexity of the VCR and the difficult operating environment in the typical transit vehicle (e.g., low-frequency vibrations, temperature extremes, and dirt particles). There is also the need to monitor and change the videotapes on a regular basis.

Sources or References

The following transit systems have rated their on-board surveillance systems as being highly effective.

- AC Transit (Oakland, California) has equipped each bus with three cameras. The equipment has helped to deter crime. AC Transit is interested in enhancing its current system and configuration.
- Akron Transit in Ohio has 41 buses equipped with CCTV cameras. It believes that the program has been very effective in reducing fraudulent claims, vandalism, and fights involving school children, as well as in providing insight about slip and fall accidents on-board.
- Community Transit (Snohomish County, Washington) has started installing one or two cameras on each bus to record altercations and accidents. Community Transit has installed CCTVs on 80–90 buses, which the agency believes deters vandals because such individuals are typically concerned about visual identification and a record of their activities.
- LYNX (Orlando, Florida) has had two CCTV cameras and a video home system (VHS) recorder on 90–95 percent of its buses since 1992. LYNX uses them for liability claims, operator discipline for off-route violations, and accident investigations.
- Valley Transit (Appleton, Wisconsin) uses the Radio Engineering Industries, Inc., (REI) Bus Watch System. Starting in 1992, Valley Transit had one live and 19 dummy units; more recently, it has six live and 32 dummy units. The surveillance system was originally installed to prevent unruly behavior by school children and has worked very well in that regard. It has also used CCTV to determine that one driver had problems in working with wheelchair securement.

Evaluation of Effectiveness

None of the transit systems that were contacted about on-board surveillance cameras had conducted any evaluation of CCTV's effectiveness. Through other study activities, the research team is aware that at least one system (SEPTA) is currently evaluating the effectiveness of on-board cameras in reducing fraudulent claims. Anecdotal information from SEPTA and other transit systems indicate that the total dollar amount of claims can be reduced by 10–20 percent by having video cameras and recorders on-board the vehicle.

Transit System or Other Contacts

AC Transit David Peery (510) 891-4807	Akron Transit Kent Weston (330) 762-7267 x3105	Community Transit Tom Glover (206) 348-7141

Valley Transit	LYNX
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Ramp-Entry, Low-Floor Buses

Summary Description

The low-floor bus (LFB) can be expected to reduce personal injury accidents due to slips, falls, and trips on the bus steps during entry and exit. The LFB will also eliminate accidents associated with the wheelchair lift. LFBs remove the internal steps that a passenger must negotiate when boarding or alighting, thereby reducing the exposure to slips, trips, and falls associated with such steps. The ramp on an LFB is not usually deployed unless there is a wheelchair user or other disabled person requiring or requesting use of the ramp. Therefore, there is typically a first step (from the curb or from the street, depending upon the stopping location of the bus), unless there is a special provision to provide a raised bus stop platform for level boarding. All LFBs have a kneeling feature such that the entry height at the front and rear doors is reduced by 3–8 in. when the bus is stopped and ready for boarding and alighting. Therefore, the actual height of the step between the curb and the bus can be quite small when boarding or alighting. It is expected that the combination of a low-step height and no internal steps at the doorways would reduce boarding and alighting accidents.

Sources or References

The following transit systems provided some additional information regarding use of ramp-entry LFBs.

- BC Transit found that the design of the entryway and vestibule area of its LFBs created a no-passenger area when entering, where there were no handholds in the event of a sudden movement of the bus. BC Transit solved this potential safety problem by attaching special bright yellow handholds to the seatback.
- Erie Metropolitan Transit Authority in Pennsylvania has received new LFBs and found that the ramps work much better than the existing platform lifts.
- OCTA (California) has LFBs with ramps at both the front and rear doors. It has had no passenger accidents with the ramps to date; however, OCTA has had passenger accidents with the wheelchair lifts on its other buses.
- Houston Metro started to receive LFBs in early 1997. It had no safety-related comments or issues, but noted that it had to be careful in routing decisions to avoid locations where there might be ground clearance problems, such as steep railroad crossings, or where there was a chance of encountering "high water," which would be above the floor height of the bus.

Evaluation of Effectiveness

Evaluations of passenger boarding and alighting accident rates for low-floor versus high-floor buses have been completed for the following transit agencies:

- Chicago Transit Authority (CTA),
- OCTA, and
- PTS.

CTA experienced no significant difference in boarding and alighting incidence rates between low-floor and high-floor buses. This surprising result is attributed, in part, to the very low number of boarding and alighting accidents over an 18-month period (a total of eight boarding and alighting accidents on LFBs versus seven on high-floor buses). This low number means that the rates are very sensitive to the proper reporting and classification of boarding and alighting accidents.

CTA also found that for LFBs, the rate of boarding accidents was much higher than the rate of alighting accidents. This same pattern was found at OCTA, but not at PTS.

OCTA showed a slightly decreased overall rate (approximately 7 percent lower) of boarding and alighting accidents on the LFBs over a 3-year period (1996–1998). This result was due to very high rates of low-floor boarding accidents in 1996 and 1997. There appears to be an "experience effect" leading to progressively lower rates of boarding accidents, as the low-floor miles and passenger trips increased by a factor of three from 1996 to 1998.

The results for PTS were straightforward. The overall rate of boarding and alighting accidents on the LFBs is approximately half the rate for the high-floor buses.

Transit System or Other Contacts

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Houston Metro	OCTA
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OPERATING ENVIRONMENT

Safety Considerations in Route Selection and Scheduling

Summary Description

This practice had the highest rating of effectiveness (by a wide margin) of all the practices in the operating environment category. Safety considerations cover all activities involved in determining whether a particular route contains any special

roadway features or traffic conditions that could have an impact on safety. The major factors affecting the safety assessment of a route include the size (length and width) of the bus; roadway geometry, including width and curvature of turns; traffic conditions; and the presence of special traffic generators, such as a parking lot or mall entrance. Safety considerations in scheduling involve a careful assessment of the time allowed to operate the route during different times of the day in order to ensure that the bus operator does not have to speed or take other chances in order to meet the schedule.

Sources or References

The following comments, from some of the transit systems that had rated their route safety practices as being highly effective, illustrate some of the different approaches to the route and schedule safety assessment.

- DTA (Duluth, Minnesota) has experienced substantial difficulty in planning routes that serve malls because of the tight turns that are required; DTA is now experimenting with the use of a small bus (Orion II) as a feeder to a full-size bus.
- Metro Transit (Seattle) conducts a complete review of the route environment and scheduling requirements whenever route changes are proposed. The review is prepared by the first-line supervisors and the safety officer.
- Marqtran (Marquette, Michigan) has an employer and employee committee that meets monthly to discuss the safety of routes, stops, and areas. There is a continuing process in place to adjust routes as required in order to avoid traffic congestion points, such as parking lots.
- Pierce Transit (Tacoma) has members of the safety committee, safety and training, and operations review all proposed new routes with planning and schedules staff. This review has reduced the number of problems that occur with a new route and resulted in the evolution of some standard guidelines.
- Richland County Transit (Ohio) has structured its routes to allow passenger boarding without crossing a highway. The agency has arranged to provide direct service to the front door of the mall to discourage walking through the mall parking lot.

Further information on safety considerations in route selection and scheduling can be found in the "Safety Improvements in the Operating Environment" sections of Chapter 2.

Evaluation of Effectiveness

No evaluation of the effectiveness of these various practices in reducing bus accidents was found.

Transit System or Other Contacts

DTA Tom Szukis (218) 722-4426 x308	Metro Transit Mike Wines (206) 684-9215	Marqtran Howard Schweppe (906) 225-1283
Pierce Transit Steven Nunan (206) 581-8060	Richland County Willie Mae Ealy (419) 522-4504	

Bus Stop Location Guidelines

Summary Description

There are three choices for the location of a bus stop: (1) far-side stops located immediately after intersections in the direction of bus travel; (2) near-side stops immediately before intersection; and (3) mid-block stops that are typically located 300 f or more from the nearest intersection. Most transit systems have developed their own bus stop guidelines on the basis of their particular route configuration, roadway geometry, traffic conditions, safety policies, and so forth. The conditions under which each of the stop options would be recommended are presented in *TCRP Synthesis of Transit Practice 18*, "Bus Occupant Safety." A more comprehensive treatment of bus stop locations is presented in *TCRP Report 19*, "Guidelines for the Location and Design of Bus Stops." This latter document provides a complete description of the general safety considerations for bus stops. The consideration include the following.

- The bus stop must be located so that passengers may alight and board with reasonable safety.
- The stopped bus will affect sight distance for pedestrians using the parallel and transverse crosswalks at the intersection.
- The stopped bus will also affect sight distance for parallel traffic and cross traffic. For instance, at a near-side stop, vehicular right turns are facilitated and sight distance is improved when the bus stop is set back from the crosswalk.
- The bus affects the traffic stream as it enters or leaves a stop.

From a safety perspective, the guidelines encourage the use of far-side stops because these stops make pedestrians more visible to motorists approaching from behind the bus. Far-side stops are also less likely to obscure traffic signals, signs, and pedestrians, and these stops reduce conflicts between buses and right-turning vehicles.

Sources or References

- *TCRP Synthesis of Transit Practice 18*, "Bus Occupant Safety" (1996).

- *TCRP Report 19*, "Guidelines for the Location and Design of Bus Stops" (1996).

Evaluation of Effectiveness

No evaluation of the effectiveness of various bus stop locations in reducing bus accidents was found.

Transit System or Other Contacts

Not Applicable.

Bus Bays

Summary Description

The bus bay (or turnout or pullout) is a specially constructed area separated from the travel lanes and off the normal section of a roadway. The bus bay allows traffic to flow freely because the stopped bus is not obstructing traffic. Bus bays are generally provided on high-volume or high-speed roadways or in heavily congested downtown and shopping areas where there are large numbers of passengers boarding and alighting.

Sources or References

The following transit systems provided some specific comments on their use of bus turnouts.

- Citibus (Lubbock, Texas), as part of providing service to Texas Tech University, required construction of a bus bay at each designated stop because of narrow roads.
- Clallam Transit (Washington) noted that it has to work with different government entities to ensure that bus bays are designed to everyone's satisfaction.
- Community Transit (Snohomish County, Washington) noted that Washington State DOT requires bus bays on roads where the speed limit exceeds 35 mph.

In addition, the following document provides comprehensive information on bus bays: *TCRP Report 19*, "Guidelines for the Location and Design of Bus Stops" (1996).

Evaluation of Effectiveness

No evaluation of the effectiveness of bus bays in preventing accidents was located.

Transit System or Other Contacts

Citibus	Clallam Transit	Community Transit
Chris Phelps	Dave Fox	Tom Glover
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Bus Stop Design Guidelines

Summary Description

In designing bus stops, transit systems must decide whether to place the bus stop on the street or off the street (i.e., whether to use bus bays), how to provide pedestrian access and ADA access, and which of the bus stop amenities to provide (e.g., waiting areas, benches, shelters, bus stop signs, public route and schedule information, and illumination). Typically, the transit system (or the municipal planning department) develops its own standards or guidelines.

Sources or References

The best source of information about bus stop design is contained in *TCRP Report 19.* Some of the transit systems that had rated their own bus stop guidelines as highly effective provided the following information.

- Anchorage Transit (Alaska) provided a copy of its *Transit Facilities Design Guidelines*, which describes the agency's recommended methodology for the location and design of bus stops.
- County Connection (California) is currently in the process of developing its own in-house bus stop location and design guidelines document.
- SamTrans (California) uses bus stop location and design guidelines developed by its planning department.

Evaluation of Effectiveness

No evaluation of the effectiveness of different bus stop design features in preventing accidents was found.

Transit System or Other Contacts

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APPENDIX A

LITERATURE SEARCH

An on-line search of numerous transportation databases for materials relevant to bus accident prevention has been completed. The databases that have been searched include those of Transportation Library Collections (e.g., Northwestern University, University of Michigan, and the National Transit Institute at Rutgers University) and Transportation Indices and Databases (e.g., TRIS, NTIS, STIS, and LOCIS/MARVEL). The results of the literature search are presented in this appendix. More than 100 publications and articles dealing with bus safety, accident prevention, and accident data and analysis are presented in the appendix, organized into the following categories:

- Background,
- Accident statistics and causes,
- Case studies, and
- Bus accident prevention initiatives.

The documents and reports that are most directly relevant to the current project are summarized in the following section.

HIGHLIGHTS OF THE LITERATURE REVIEW

"Analysis of Bus Accidents: Empirical, Methodological, and Policy Issues" (Jovanis, Schofer, Prevedouros, and Tsunokawa, 1991). This study analyzes the characteristics of 1,800 accidents that occurred over a 3-year period (1982–1984) at Pace, a medium-size bus system in suburban Chicago. The study seeks correlations between accident rates and numerous operating characteristics, such as the following: environment, driver traits (e.g., age, experience, and gender), time of day, and service policies. The study looks at the difference between collision and noncollision accidents. While several characteristics have strong correlations, the study did not conclude that they were causal factors.

Accident Facts (National Safety Council, 1996). This annual reference document compiles statistics on accidents and their resulting injuries, fatalities, and property damage. Information on accidents associated with public transportation is a small component of this comprehensive document (information on accidents associated with transit buses is an even smaller component). The primary value of this document is to provide a context and comparison with the magnitude and characteristics of other types of accidents.

Characteristics and Solutions Related to Bus Transit Accidents (Zegeer, Huang, Hummer, Stutts, Rodgman, and Fruin, 1993). This study provides a detailed analysis of nearly 9,000 nonschool bus accidents from five states (Illinois, Maine, Michigan, Minnesota, and Utah) over a 5-year period (January 1985–December 1989). It also analyzes more than 5,000 noncollision passenger injuries that took place on Washington Metropolitan Area Transit Authority (WMATA) buses from 1984 to 1991. The accident data were examined to determine causal factors and, consequently, to identify measures to reduce the number and severity of accidents. The study proposes improvements to roadway design and traffic configuration, bus stop placement and design, design of bus interiors, driver training, transit agency safety programs, and accident data collection. The primary author is a member of the TMS project team.

"Working on the Hot Seat: Urban Bus Operators" (Evans, 1994). This article reviews findings about the difficult work environment of bus operators. It cites health and death statistics as strong evidence of the work-induced stress placed on bus operators. Beyond concern about the well-being of bus operators, it points out the cost incurred by the industry via levels of absenteeism, worker's compensation, and disability claims that are much higher than the average for blue collar jobs. The article points out that the three general responsibilities of operators (i.e., safety, schedule adherence, and customer service) are often at odds with each other. The author recommends policy and technology improvements to improve the operating environment.

1996 Annual Report (New York State DOT, Public Transportation Safety Board, 1997). This report summarizes the activities of the PTSB, an agency that oversees the safety of transportation agencies that receive New York State operating assistance; these agencies include bus and rail systems, both public and private. Included in the report are statistics concerning 624 bus accidents (1990–1996) for which PTSB conducted investigations. For each of these accidents, PTSB goes beyond describing the characteristics of the accident: it assigns a "primary probable cause," which is defined as "the action or factor that directly facilitates the initial event of an accident." In addition, for each accident investigated, PTSB issues one or more recommendations to the affected bus or rail system.

"Selecting Bus Drivers: Multiple Predictors, Multiple Perspectives on Validity, and Multiple Estimates of Utility" (Jacobs, Conte, Day, Silva, and Harris, 1996). Under contract to APTA, the authors of this article identified attitudes, personality traits, and cognitive skills that would be good predictors of whether an individual would be a good bus operator. Then the authors created a series of written tests to measure these predictors. These written tests were given to 864 bus operators at nine transit systems. The performance of the operators on these tests correlated well with their actual job performance with respect to attendance and safety. APTA now

offers this Bus Operator Selection Survey (BOSS) program to its bus systems members. The authors plan to follow up their initial work with actual results from the use of BOSS.

Guidelines for the Location and Design of Bus Stops (Fitzpatrick, 1996). This TCRP report presents the findings and recommendations from research to improve bus stops for passengers and buses, as well as for other pedestrians and vehicles. Safety is a consideration during all stages of the locating, design, and construction (or renovation) of a bus stop. Specific discussion of safety issues includes placement of stops at the far side of an intersection; street and sidewalk conditions; curb heights; lighting; and the interaction of the stopping bus with pedestrians and other traffic.

Bus Occupant Safety (King, 1996). This TCRP synthesis presents information on the current practices of bus transit systems to reduce the number and severity of passenger injuries in both collision and noncollision accidents. The synthesis uses the survey responses of 35 transit systems, 32 state DOTs, and six transit management firms to describe the safety practices in use, including training programs, employee incentive programs, management tools, and vehicle technology improvements. While a variety of practices are in place and appear effective, few transit systems (or researchers) have conducted systematic evaluations of these safety measures. The author is a member of the TMS project team.

Risk Management for Small and Medium Transit Agencies (Kaddatz, 1995). This TCRP synthesis reports on the ways in which small bus transit systems (as defined by the FTA, fewer than 100 vehicles) handle risk management issues: who makes decisions, what practices are in common use, and how these practices are integrated with a bus system's overall operations and administration. The synthesis uses the survey responses from 34 transit systems, all with service area populations under 400,000. A majority of the respondents have turned to self-insurance or statewide pools with other transit systems. They have incorporated risk management ideas into administration and operations. However, they have not evaluated the safety, training, and loss control practices to determine which are the most cost-effective. The author is a member of the TMS project team.

"Public Transport Passenger Accidents: An Analysis of the Structural and Functional Characteristics of Passenger and Vehicle" (Hudenski, 1992). This article analyzes noncollision passenger accidents that occurred at the San Francisco Municipal Railway (Muni) during 1989 for all modes (i.e., motor bus, trolley bus, light rail, and cable car). The data indicate that elderly passengers were involved in a disproportionate number of these accidents. In addition, there were proportionally more accidents involving three-step (as opposed to two-step) vehicles and vehicles with inwardly opening doors (as opposed to outwardly or sideways opening). The article offers recommendations on the basis of these findings. The author of this article is a member of the Muni staff.

Safety Management Information Statistics (SAMIS) Report, 1990–1995 (FTA, U.S.DOT). This annual report compiles safety statistics reported by transit systems to the National Transit Database (formerly Section 15). The report aggregates safety data by mode, displays trends over time, and presents incident rates per various operating measures (e.g., passenger trip, vehicle mile, and passenger mile). For transit buses, the report divides the transit system into large, medium, and small fleets. Beginning with the 1995 edition, the report presents security data submitted by transit systems in urbanized areas with populations greater than 200,000.

The findings from the literature review show that there is a substantial body of work on bus accident data and analysis, but there is virtually no information on the effectiveness of various bus accident prevention practices. There is one document, *TCRP Synthesis of Transit Practice 18*, "Bus Occupant Safety," which has to be considered a detailed introduction or complement to the current project because it provides a broad outline of many transit industry practices for the reduction of accidents and incidents. This synthesis also includes many examples and illustrations of specific programs and forms that are actually used by transit systems. The Bus Occupant Safety report is a valuable complement to the current research.

BACKGROUND

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APPENDIX B

ACCIDENT PREVENTION PRACTICES AMONG TRANSIT SYSTEMS

INTRODUCTION

A major objective of the research was to obtain information directly from the transit industry regarding the use of different accident prevention practices and to find out which practices were considered to be "highly effective." In accordance with the work plan, the TMS project team collected this information via a specially designed form that was mailed directly to 433 transit systems in the United States and to five systems in Canada.

To ensure a maximum response, the form—"Request for Information on Bus Accident Prevention Practices"—was designed as a check-off form, in which the respondents indicated that they used a particular practice or program and then checked off a box ranking the practice as highly effective, moderately effective, not effective, or don't know.

The accident prevention practices were organized into the following categories to allow the respondents to more easily identify and check off specific practices:

- Driver selection and hiring,
- Driver training (classroom or in-vehicle),
- Safe driver incentive programs,
- Customer safety programs,
- Management practices and programs,
- Bus technology safety improvements, and
- Operating environment.

The mailing information on the transit systems was derived from the Federal Transit Administration's National Transit Database. The research team refined the information on contact names to identify particular individuals concerned with bus safety who should receive the form. This customized database resulted in a very satisfactory rate of return of forms.

The transit systems were divided into two groups. Transit systems that were found to have a record of exemplary safety performance were identified as Group 1 systems, and the rest were assigned to Group 2. A total of 99 transit systems (including 5 Canadian systems) were selected for Group 1 because they belong to one or more of the following groups:

- Transit systems identified by transit insurance pools as exemplary systems,
- Transit systems receiving top awards in APTA's Bus Safety Award Competition (1994–1996), and
- Transit systems demonstrating a consistent record of low rates of collision accidents and injuries per million vehicle miles.

The Group 1 systems were targeted for concentrated follow-up in the form of telephone calls to encourage participation and to ensure that the systems would be willing to provide detailed information on accident prevention programs and practices and evaluation data. The assignment of a transit system to Group 2 does **not** mean that the system has a less than exemplary safety performance record. The Group 1 designation was limited to approximately 100 systems because this limit was sufficient for the purpose of detailed data collection.

RESPONSES TO THE REQUEST-FOR-INFORMATION FORM

The mailing of the "Request for Information on Bus Accident Prevention Practices" form was completed in March 1997. Forms and customized letters were sent to 99 Group 1 (i.e., exemplary safety performance) transit systems and 339 Group 2 (i.e., *not necessarily* exemplary safety performance) transit systems.

A total of 182 completed forms were received. This number includes 69 from Group 1 systems (a 70-percent response rate) and 113 from Group 2 systems (a 33-percent response rate). On an overall basis, the 182 responses of the 438 forms that were sent out to transit systems in the United States and Canada amounted to a total response rate of 42 percent. This response rate is considered to be very high and well over the original TMS projections of an approximate 30 percent.

The fleet size of the 182 responding transit systems is structured as follows:

- Small bus fleets (i.e., fleets with fewer than 100 buses operated) yielded 135 respondents,
- Medium bus fleets (i.e., fleets with 100–500 buses operated) yielded 33 respondents, and
- Large bus fleets (i.e., fleets with more than 500 buses operated) yielded 14 respondents.

The information provided by the respondents is considered to represent transit systems nationwide, as shown by the statistics in Table B1.

Figure B1 provides a complete list of the 182 responding transit systems. Each transit system list contains an identification number (either the one assigned by FTA or, if unavailable, a special identification number assigned by TMS), the transit system name, and the state in which the system is located. The list also indicates whether the system fleet size is small (S), medium (M), or large (L) in accordance with

(*text continues on page B-11*)

TABLE B1 Number and percentage of responses to the request-for-information form

System Size	Number of Systems	Responses Received	Percentage Received
Small	340	135	40%
Medium	75	33	44%
Large	23	14	61%
Total	**438**	**182**	**42%**

ID No.	Transit System	State	Size	Group
0001	King County Department of Metropolitan Svcs (Seattle Metro)	WA	L	1
0003	Pierce Transit	WA	M	1
0006	Yakima Transit	WA	S	1
0007	Lane Transit District	OR	S	2
0011	Boise Urban Stages	ID	S	1
0012	Anchorage Public Transit	AK	S	1
0016	Community Urban Bus Service	WA	S	2
0018	Ben Franklin Transit	WA	S	1
0020	Kitsap Transit	WA	S	2
0024	Clark County Public Transportation (C-Tran)	WA	S	2
0029	Community Transit	WA	S	1
0cla	Clallam Transit	WA	S	1
0lnk	Link	WA	S	1
0pac	Pacific Transit	WA	S	1
1001	Rhode Island Public Transit Authority	RI	M	2
1002	Manchester Transit Authority	NH	S	2
1003	Massachusetts Bay Transportation Authority	MA	L	2
1007	Berkshire Regional Transit Authority	MA	S	2
1008	Pioneer Valley Transit Authority	MA	S	2

Figure B1. Respondents of the request-for-information form.

ID No.	Transit System	State	Size	Group
1013	Merrimack Valley Regional Transit Authority	MA	S	2
1014	Worcester Regional Transit Authority	MA	S	1
1016	Greater Portland Transit District	ME	S	1
1048	Connecticut Transit	CT	M	1
1049	Greater New Haven Transit District	CT	S	2
1050	Greater Bridgeport Transit District	CT	S	2
1052	New Britain Transportation	CT	S	2
1057	Norwalk Transit District	CT	S	1
1063	Middletown Transit District	CT	S	2
1064	Greater Attleboro-Taunton Regional Transit Authority	MA	S	2
1096	City of Bangor	ME	S	2
1105	Cape Cod Transit Authority	MA	S	1
2002	Capital District Transportation Authority	NY	M	1
2006	City of Long Beach	NY	S	2
2007	MTA Long Island Bus	NY	M	1
2008	MTA New York City Transit	NY	L	1
2015	VIP Transportation (Rome)	NY	S	2
2021	Utica Transit Authority	NY	S	1
2080	New Jersey Transit	NJ	L	1
2148	Newburgh Beacon Bus	NY	S	2
2149	Rockland Coaches, Inc.	NY	S	2

Figure B1. (*Continued*)

(*continued on next page*)

ID No.	Transit System	State	Size	Group
3001	Kanawha Valley Regional Transportation Authority	WV	S	2
3002	Tri-State Transit Authority	WV	S	2
3005	Tidewater Transportation District Commission	VA	M	2
3006	Greater Richmond Transit Company	VA	M	1
3007	Greater Roanoke Transit Company	VA	S	2
3010	Lehigh and Northampton Transportation Authority	PA	S	2
3011	Altoona Metro Transit	PA	S	2
3013	Erie Metropolitan Transit Authority	PA	S	1
3018	Red Rose Transit Authority	PA	S	1
3024	Berks Area Reading Transportation Authority	PA	S	2
3035	Ohio Valley Regional Transportation Authority	WV	S	2
3040	Annapolis Department of Public Transportation	MD	S	2
3045	JAUNT	VA	S	2
3053	Bristol Transit	VA	S	2
3066	Weirton Transit Corporation	WV	S	2
4001	Chattanooga Area Regional Transportation Authority	TN	S	1
4002	Knoxville Transportation Authority	TN	S	1
4004	Metropolitan Transit Authority (Nashville)	TN	M	1
4007	Capital Area Transit	NC	S	2
4010	Gastonia Transit	NC	S	2
4018	Transit Authority of River City	KY	M	2

Figure B1. (*Continued*)

ID No.	Transit System	State	Size	Group
4019	Transit Authority of Northern Kentucky	KY	S	2
4021	Albany Transit System	GA	S	2
4022	Metropolitan Atlanta Rapid Transit Authority	GA	L	1
4024	Columbus Transit System	GA	S	2
4029	Broward County Transit	FL	M	2
4030	Gainesville Regional Transit System	FL	S	2
4032	VOTRAN	FL	S	1
4034	Metro-Dade Transit Agency	FL	L	2
4035	LYNX	FL	M	1
4037	CoTran	FL	S	2
4046	Sarasota County Transportation Authority	FL	S	2
4051	Chapel Hill Transit	NC	S	1
4056	Pee Dee Regional Transportation Authority	SC	S	2
4063	Space Coast Area Transit	FL	S	1
4074	Pasco County Public Transportation	FL	S	2
4080	City of Kingsport	TN	S	2
4086	Metropolitan Bus Authority (San Juan)	PR	M	2
4087	Durham Area Transit Authority	NC	S	2
4090	Piedmont Wagon	NC	S	2
4092	Clarksville Transit System	TN	S	2

Figure B1. (*Continued*)

(*continued on next page*)

ID No.	Transit System	State	Size	Group
4095	Greenville Area Transit	NC	S	2
5001	City of Appleton-Valley Transit	WI	S	1
5002	Green Bay Transit	WI	S	2
5004	LaCrosse Municipal Transit Utility	WI	S	2
5005	Madison Metro Transit	WI	M	1
5010	Metro Regional Transit Authority (Akron)	OH	M	1
5015	Greater Cleveland Regional Transit Authority	OH	L	1
5017	Miami Valley Regional Transit Authority	OH	S	2
5022	Toledo Area Regional Transit Authority	OH	M	1
5025	Duluth Transit Authority	MN	M	1
5027	Metropolitan Council Transit (Minneapolis-St. Paul)	MN	L	1
5030	Battle Creek Transit	MI	S	2
5031	SMART (Detroit)	MI	M	2
5033	Grand Rapids Area Transit Authority	MI	S	2
5034	Jackson Transportation Authority	MI	S	1
5040	Ann Arbor Transportation Authority	MI	S	2
5041	Anderson Transportation System	IN	S	2
5043	Metropolitan Evansville Transit System	IN	S	2
5058	Rockford Mass Transit District	IL	S	2
5060	Champaign-Urbana Mass Transit District	IL	S	2

Figure B1. (*Continued*)

ID No.	Transit System	State	Size	Group
5061	Decatur Public Transit System	IL	S	2
5090	Richland County Transit	OH	S	1
5092	City Lines (Rochester)	MN	S	2
5108	Janesville Transit System	WI	S	2
5109	Beloit Transit System	WI	S	1
5117	Laketran	OH	S	1
5142	Steel Valley Transit Corporation	OH	S	2
5maq	Marqtran	MI	S	1
6006	Sun Metro (El Paso)	TX	M	1
6008	Metropolitan Transit Authority (Houston)	TX	L	1
6009	Laredo Municipal Transit System	TX	S	2
6010	Citibus (Lubbock)	TX	S	1
6012	Waco Transit System, Inc.	TX	S	2
6013	Port Arthur Transit	TX	S	2
6017	Central Oklahoma Transit & Parking Authority	OK	S	2
6018	Metropolitan Tulsa Transit Authority	OK	S	1
6019	Sun Tran of Albuquerque	NM	M	1
6023	Lake Charles Transit System	LA	S	2
6025	ATrans (Alexandria)	LA	S	2
6026	Monroe Transit System	LA	S	2
6032	Regional Transit Authority (New Orleans)	LA	M	2

Figure B1. (*Continued*)

(*continued on next page*)

ID No.	Transit System	State	Size	Group
6033	Central Arkansas Transit Authority	AR	S	1
6034	Pine Bluff Transit	AR	S	2
6035	Wichita Falls Transit System	TX	S	2
6040	Abilene Transit System	TX	S	2
6049	Las Cruces Area Transit-RoadRUNNER	NM	S	2
6051	Corpus Christi Regional Transportation Authority	TX	S	2
6076	City of Denton	TX	S	2
6077	Santa Fe Trails	NM	S	2
7001	StarTran (Lincoln)	NE	S	2
7002	Metro Area Transit (Omaha)	NE	M	1
7003	City Utilities of Springfield	MO	S	1
7008	Five Seasons Transportation	IA	S	2
7009	Davenport Public Transit	IA	S	2
7010	Des Moines Metropolitan Transit Authority	IA	S	1
7013	Metropolitan Transit Authority of Black Hawk County	IA	S	2
7015	Wichita Metropolitan Transit Authority	KS	S	2
7030	Coralville Transit	IA	S	2
7ame	Ames Transit	IA	S	1
8003	Fargo Metropolitan Area Transit	ND	S	2
8005	Colorado Springs Transit System	CO	S	1

Figure B1. (*Continued*)

ID No.	Transit System	State	Size	Group
8006	Regional Transportation District (Denver)	CO	L	1
8010	City of Greeley-The Bus	CO	S	2
8012	Great Falls Transit District	MT	S	2
8013	Casper Area Transit Coalition	WY	S	2
9001	Regional Transportation Commission (Reno)	NV	S	1
9002	Oahu Transit Service	HI	M	2
9006	Santa Cruz Metropolitan Transit District	CA	S	1
9009	San Mateo County Transit District	CA	M	1
9012	San Joaquin Regional Transit District	CA	S	2
9013	Santa Clara County Transit District	CA	M	2
9014	Alameda-Contra Costa Transit District	CA	L	1
9015	San Francisco Municipal Railway	CA	L	1
9016	Golden Gate Bridge, Highway and Transportation District	CA	M	2
9019	Sacramento Regional Transit District	CA	M	2
9020	Santa Barbara Metropolitan Transit District	CA	S	1
9024	La Mirada Transit	CA	S	2
9026	San Diego Transit Corporation	CA	M	2
9027	Fresno Area Express	CA	S	2
9029	OMNITRANS	CA	S	2
9030	North San Diego County Transit	CA	M	1

Figure B1. (*Continued*)

(*continued on next page*)

ID No.	Transit System	State	Size	Group
9031	Riverside Transit Agency	CA	S	2
9033	Sun Tran (Tucson)	AZ	M	1
9035	South Coast Area Transit	CA	S	2
9036	Orange County Transportation Authority	CA	M	1
9041	Montebello Municipal Bus Lines	CA	S	2
9062	Monterey-Salinas Transit	CA	S	2
9078	Central Contra Costa Transit Authority	CA	M	1
9079	SunLine Transit Agency	CA	S	2
9088	Napa Valley Transit	CA	S	2
9089	Sonoma County Transit	CA	S	2
9092	Fairfield Transit System	CA	S	2
9093	Redding Area Bus Authority	CA	S	2
9119	Laguna Beach Municipal Transit Lines	CA	S	2
9121	Antelope Valley Transit Authority	CA	S	2
9136	Regional Public Transportation Authority (Phoenix)	AZ	M	1
9148	Victor Valley Transit Service Authority	CA	S	2
9149	Lompoc Transit	CA	S	2
cbct	BC Transit	BC	L	1
cmis	Mississauga Transit	ON	M	1
cttc	Toronto Transit Commission	ON	L	1

Figure B1. (*Continued*)

previous definitions, and whether the system was assigned to Group 1 or Group 2.

SUMMARY OF RESPONSES

Table B2 summarizes the responses from all 182 transit systems. The amount of information contained in the table makes it difficult to understand specific trends and relationships regarding the use and effectiveness of different practices; therefore, some of this information is presented in a graphical format later in this section. There are, however, some general comments and observations to be made prior to a discussion of the detailed results for each category.

In Table B2, the term "other," which is listed as the last item on the list of practices for each category, refers to the transit systems that described accident prevention practices other than those listed on the form. The interim report for this project describes those "other practices" in its detailed discussion of results by accident prevention practice category.

The legend at the end of Table B2 describes each of the column headings. The column heading "Incomplete" refers to entries on the request-for-information form, in which respondents indicated that they "use" a particular accident prevention practice, but did not mark any of the ratings boxes. The percentages shown in the effectiveness ratings, including the incomplete responses, do not always add up to 100 percent because of round-off error.

TABLE B2 Use and effectiveness ratings of safety practices (based on responses from 182 transit systems)

Practice	USED	HE	ME	NE	DK	INC
A. Driver Selection & Hiring						
Personal Interviews	98%	53%	44%	2%	1%	1%
Screening Tests	48%	38%	44%	10%	5%	3%
Pre-employment Physical	92%	46%	48%	4%	1%	1%
Math or Reading Test	28%	16%	61%	10%	14%	0%
Map Orientation Test	29%	27%	46%	6%	19%	2%
Other	35%	59%	30%	0%	0%	11%
B. Driver Training						
Defensive Driving	97%	68%	29%	1%	1%	2%
Emergency Procedures	92%	46%	48%	3%	2%	2%
Driver Training Simulator	16%	40%	27%	0%	30%	3%
Passenger Sensitivity	90%	40%	57%	1%	1%	2%
ADA-Related	90%	38%	55%	4%	1%	2%
Other	25%	54%	35%	0%	2%	9%
C. Safe Driver Incentive Programs						
Safety Awards or Recognition	85%	41%	55%	2%	2%	1%
Bonuses or Prizes	47%	45%	47%	5%	3%	0%
Perks or Privileges	19%	37%	49%	9%	6%	0%
Other	9%	18%	65%	6%	0%	12%

(*continued on next page*)

TABLE B2 (Continued)

Practice	USED	HE	ME	NE	DK	INC
D. Customer Safety Programs						
Customer Educational Programs	42%	25%	61%	7%	7%	1%
Passenger Training	55%	46%	46%	2%	6%	1%
Ed Programs for School Children	60%	33%	49%	7%	9%	2%
Other	5%	56%	11%	0%	22%	11%
E. Management Practices & Programs						
System Safety Program	76%	46%	49%	1%	0%	4%
Safety Committee for Accident Review	75%	47%	45%	6%	1%	1%
Safety Audits of Bus Operations	60%	45%	53%	1%	1%	0%
Vehicle Safety Inspections	93%	60%	34%	2%	1%	3%
Incentive Programs for Management	15%	30%	41%	15%	15%	0%
Ride Checks	86%	37%	54%	6%	1%	2%
Computerized Database	47%	41%	41%	9%	8%	1%
Programs for “Accident Repeater” Drivers	69%	49%	44%	3%	0%	3%
Questionable or False Claims Program	30%	49%	31%	7%	11%	2%
Other	8%	73%	13%	0%	7%	7%
F. Bus Technology Improvements						
Driver Workstation	39%	44%	48%	1%	7%	0%
Driver Vision or Mirrors	79%	65%	31%	2%	1%	0%
Doors and Door Controls	60%	52%	45%	4%	0%	0%

TABLE B2 (Continued)

Practice	USED	HE	ME	NE	DK	INC
Stepwell Ice or Snow Removal	40%	42%	55%	1%	1%	0%
Ramp Entry-Low Floor Bus	26%	52%	35%	2%	10%	0%
Lighting	57%	43%	55%	1%	1%	0%
Daytime Running Lights	58%	50%	35%	6%	9%	0%
Brake Lights or Warning Signs	69%	50%	40%	2%	6%	2%
Deceleration Alert System	34%	49%	30%	10%	11%	0%
On-Board Surveillance Cameras	26%	46%	35%	4%	15%	0%
Black Box Recorder	7%	17%	8%	8%	67%	0%
Other	8%	57%	36%	0%	0%	7%
G. Operating Environment						
Bus Stop Location Guidelines	65%	41%	51%	1%	6%	1%
Bus Stop Design Guidelines	49%	42%	50%	0%	7%	1%
Bus Bays	57%	45%	49%	2%	3%	1%
Bus Stop Maintenance	47%	48%	43%	3%	5%	1%
Safety Considerations in Route Selection or Scheduling	76%	59%	36%	0%	4%	1%
Special Traffic and Parking	32%	37%	44%	12%	7%	0%
Other	6%	73%	27%	0%	0%	0%

LEGEND			
USED	Used at System	NE	Not Effective
HE	Highly Effective	DK	Don't Know
ME	Moderately Effective	INC	Incomplete

One of the first observations from Table B2 is the wide range in the number of transit systems that use a particular practice; 98 percent of the respondents use personal interviews in the "Driver Selection and Hiring" category, while only 7 percent indicate that they use black box recorders as part of "Bus Technology Safety Improvements." In general, the practices that are used at 75 percent or more of the respondent systems can be considered as a standard safety practice within the bus transit industry, while those that are used by 50–75 percent of the systems can be considered to be popular practices. Those practices that are used by less than 50 percent of the respondents may be due to lack of information and knowledge about the practice, the fact that the practice represents new technology or that the practice is expensive, or simply the fact that the systems have tried the practice and stopped using it because it did not prove to be effective in reducing accidents.

In some cases, it was necessary to examine the effects of system fleet size on the use of a particular practice. Table B3

(*text continues on page B-22*)

TABLE B3 Use and effectiveness ratings for accident prevention practices

Part A: Based on responses from 135 small bus systems

Practice	USED	HE	ME	NE	DK	INC
A. Driver Selection & Hiring						
Personal Interviews	99%	52%	46%	0%	1%	1%
Screening Tests	42%	33%	46%	9%	7%	5%
Pre-employment Physical	93%	43%	50%	4%	1%	2%
Math/Reading Test	26%	14%	57%	11%	17%	0%
Map Orientation Test	26%	29%	43%	3%	23%	3%
Other	36%	65%	29%	0%	0%	6%
B. Driver Training						
Defensive Driving	96%	68%	29%	1%	1%	1%
Emergency Procedures	91%	41%	51%	3%	2%	2%
Driver Training Simulator	15%	30%	30%	0%	40%	0%
Passenger Sensitivity	87%	36%	60%	2%	1%	2%
ADA-Related	89%	33%	59%	5%	0%	3%
Other	22%	50%	40%	0%	3%	7%
C. Safe Driver Incentive Programs						
Safety Awards/Recognition	81%	43%	54%	1%	3%	0%
Bonuses/Prizes	50%	50%	43%	3%	4%	0%
Perks/Privileges	19%	38%	46%	8%	8%	0%
Other	10%	15%	62%	8%	0%	15%
D. Customer Safety Programs						
Customer Educational Programs	35%	30%	51%	9%	11%	0%
Passenger Training	54%	42%	45%	3%	8%	1%
Ed Programs for School Children	56%	32%	47%	7%	13%	1%
Other	3%	50%	0%	0%	25%	25%

TABLE B3 (Continued)

Practice	USED	HE	ME	NE	DK	INC
E. Management Practices & Programs						
System Safety Program	76%	49%	46%	1%	0%	4%
Safety Committee for Accident Review	76%	49%	43%	7%	2%	0%
Safety Audits of Bus Operations	56%	47%	51%	1%	0%	0%
Vehicle Safety Inspections	94%	61%	34%	2%	1%	2%
Incentive Programs for Management	16%	33%	38%	10%	19%	0%
Ride Checks	84%	37%	55%	6%	0%	2%
Computerized Database	38%	33%	47%	10%	10%	0%
Programs for “Accident Repeater” Drivers	61%	48%	46%	4%	0%	2%
Questionable/False Claims Program	29%	49%	33%	8%	8%	3%
Other	9%	67%	17%	0%	8%	8%
F. Bus Technology Improvements						
Driver Workstation	34%	43%	46%	2%	9%	0%
Driver Vision/Mirrors	79%	64%	33%	1%	2%	0%
Doors and Door Controls	60%	49%	47%	4%	0%	0%
Stepwell Ice/Snow Removal	41%	46%	50%	2%	2%	0%
Ramp Entry-Low Floor Bus	26%	51%	34%	0%	14%	0%
Lighting	53%	42%	58%	0%	0%	0%
Daytime Running Lights	55%	54%	32%	5%	8%	0%
Brake Lights/Warning Signs	66%	48%	43%	1%	7%	1%
Deceleration Alert System	33%	49%	31%	9%	11%	0%
On-Board Surveillance Cameras	22%	50%	33%	0%	17%	0%
Black Box Recorder	8%	18%	9%	9%	64%	0%
Other	7%	67%	33%	0%	0%	0%

(*continued on next page*)

TABLE B3 (Continued)

G. Operating Environment						
Bus Stop Location Guidelines	63%	42%	53%	0%	5%	0%
Bus Stop Design Guidelines	41%	45%	50%	0%	5%	0%
Bus Bays	53%	47%	49%	3%	1%	0%
Bus Stop Maintenance	45%	52%	44%	2%	2%	0%
Safety Considerations in Route Selection/Scheduling	76%	63%	31%	0%	5%	1%
Special Traffic and Parking	25%	44%	41%	9%	6%	0%
Other	6%	75%	25%	0%	0%	0%

LEGEND	
USED	Used at System
HE	Highly Effective
ME	Moderately Effective
NE	Not Effective
DK	Don’t Know
INC	Incomplete

TABLE B3 (Continued)

Part B: Based on responses from 33 medium bus systems

Practice	USED	HE	ME	NE	DK	INC
A. Driver Selection & Hiring						
Personal Interviews	97%	50%	38%	13%	0%	0%
Screening Tests	64%	33%	48%	19%	0%	0%
Pre-employment Physical	88%	48%	48%	3%	0%	0%
Math/Reading Test	36%	25%	67%	8%	0%	0%
Map Orientation Test	36%	33%	50%	17%	0%	0%
Other	33%	45%	27%	0%	0%	27%
B. Driver Training						
Defensive Driving	100%	73%	24%	0%	0%	3%
Emergency Procedures	94%	61%	35%	3%	0%	0%
Driver Training Simulator	18%	50%	33%	0%	17%	0%
Passenger Sensitivity	97%	53%	47%	0%	0%	0%
ADA-Related	94%	52%	45%	0%	3%	0%
Other	33%	73%	18%	0%	0%	9%
C. Safe Driver Incentive Programs						
Safety Awards/Recognition	94%	35%	55%	6%	0%	3%
Bonuses/Prizes	39%	31%	54%	15%	0%	0%
Perks/Privileges	18%	33%	50%	17%	0%	0%
Other	6%	50%	50%	0%	0%	0%
D. Customer Safety Programs						
Customer Educational Programs	48%	13%	81%	0%	0%	6%
Passenger Training	64%	52%	48%	0%	0%	0%
Ed Programs for School Children	73%	33%	54%	8%	0%	4%
Other	12%	50%	25%	0%	25%	0%

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TABLE B3 (Continued)

E. Management Practices & Programs						
System Safety Program	73%	29%	67%	0%	0%	4%
Safety Committee for Accident Review	79%	38%	54%	4%	0%	4%
Safety Audits of Bus Operations	64%	24%	76%	0%	0%	0%
Vehicle Safety Inspections	88%	52%	38%	3%	0%	7%
Incentive Programs for Management	6%	0%	50%	50%	0%	0%
Ride Checks	85%	39%	50%	4%	4%	4%
Computerized Database	73%	46%	38%	8%	4%	4%
Programs for “Accident Repeater” Drivers	91%	43%	47%	3%	0%	7%
Questionable/False Claims Program	33%	45%	18%	9%	27%	0%
Other	6%	100%	0%	0%	0%	0%
F. Bus Technology Improvements						
Driver Workstation	48%	31%	63%	0%	6%	0%
Driver Vision/Mirrors	76%	64%	28%	8%	0%	0%
Doors and Door Controls	61%	50%	45%	5%	0%	0%
Stepwell Ice/Snow Removal	33%	18%	82%	0%	0%	0%
Ramp Entry-Low Floor Bus	27%	56%	33%	11%	0%	0%
Lighting	70%	43%	48%	4%	4%	0%
Daytime Running Lights	67%	45%	32%	9%	14%	0%
Brake Lights/Warning Signs	67%	59%	32%	9%	0%	0%
Deceleration Alert System	39%	54%	23%	15%	8%	0%
On-Board Surveillance Cameras	36%	33%	42%	17%	8%	0%
Black Box Recorder	3%	0%	0%	0%	100%	0%
Other	12%	25%	50%	0%	0%	25%

TABLE B3 (Continued)

G. Operating Environment						
Bus Stop Location Guidelines	70%	30%	57%	0%	9%	4%
Bus Stop Design Guidelines	67%	36%	50%	0%	9%	5%
Bus Bays	64%	33%	52%	0%	10%	5%
Bus Stop Maintenance	48%	38%	31%	6%	19%	6%
Safety Considerations in Route Selection/Scheduling	79%	38%	58%	0%	0%	4%
Special Traffic and Parking	45%	27%	40%	20%	13%	0%
Other	6%	50%	50%	0%	0%	0%

LEGEND	
USED	Used at System
HE	Highly Effective
ME	Moderately Effective
NE	Not Effective
DK	Don’t Know
INC	Incomplete

(*continued on next page*)

TABLE B3 (Continued)

Part C: Based on responses from 14 large bus systems

Practice	USED	HE	ME	NE	DK	INC
A. Driver Selection & Hiring						
Personal Interviews	93%	62%	38%	0%	0%	0%
Screening Tests	71%	70%	30%	0%	0%	0%
Pre-employment Physical	93%	69%	23%	8%	0%	0%
Math/Reading Test	29%	0%	75%	0%	25%	0%
Map Orientation Test	36%	0%	60%	0%	40%	0%
Other	29%	25%	50%	0%	0%	25%
B. Driver Training						
Defensive Driving	100%	57%	36%	0%	0%	7%
Emergency Procedures	100%	50%	43%	0%	0%	7%
Driver Training Simulator	29%	75%	0%	0%	0%	25%
Passenger Sensitivity	100%	43%	50%	0%	0%	7%
ADA-Related	93%	54%	38%	0%	0%	8%
Other	36%	40%	40%	0%	0%	20%
C. Safe Driver Incentive Programs						
Safety Awards/Recognition	93%	38%	62%	0%	0%	0%
Bonuses/Prizes	36%	20%	80%	0%	0%	0%
Perks/Privileges	21%	33%	67%	0%	0%	0%
Other	14%	0%	100%	0%	0%	0%
D. Customer Safety Programs						
Customer Educational Programs	93%	23%	69%	8%	0%	0%
Passenger Training	50%	57%	43%	0%	0%	0%
Ed Programs for School Children	64%	44%	44%	11%	0%	0%
Other	7%	100%	0%	0%	0%	0%

TABLE B3 (Continued)

E. Management Practices & Programs						
System Safety Program	93%	54%	38%	8%	0%	0%
Safety Committee for Accident Review	57%	63%	38%	0%	0%	0%
Safety Audits of Bus Operations	86%	67%	25%	0%	8%	0%
Vehicle Safety Inspections	93%	69%	31%	0%	0%	0%
Incentive Programs for Management	29%	25%	50%	25%	0%	0%
Ride Checks	100%	36%	50%	14%	0%	0%
Computerized Database	79%	64%	18%	9%	9%	0%
Programs for "Accident Repeater" Drivers	93%	69%	31%	0%	0%	0%
Questionable/False Claims Program	36%	60%	40%	0%	0%	0%
Other	7%	100%	0%	0%	0%	0%
F. Bus Technology Improvements						
Driver Workstation	64%	67%	33%	0%	0%	0%
Driver Vision/Mirrors	86%	75%	25%	0%	0%	0%
Doors and Door Controls	64%	78%	22%	0%	0%	0%
Stepwell Ice/Snow Removal	43%	50%	50%	0%	0%	0%
Ramp Entry-Low Floor Bus	29%	50%	50%	0%	0%	0%
Lighting	64%	44%	56%	0%	0%	0%
Daytime Running Lights	71%	30%	60%	0%	10%	0%
Brake Lights/Warning Signs	100%	50%	36%	0%	7%	7%
Deceleration Alert System	21%	33%	33%	0%	33%	0%
On-Board Surveillance Cameras	43%	50%	33%	0%	17%	0%
Black Box Recorder	0%	—	—	—	—	—
Other	7%	100%	0%	0%	0%	0%

(*continued on next page*)

TABLE B3 (Continued)

G. Operating Environment						
Bus Stop Location Guidelines	79%	55%	27%	9%	9%	0%
Bus Stop Design Guidelines	86%	42%	50%	0%	8%	0%
Bus Bays	79%	55%	45%	0%	0%	0%
Bus Stop Maintenance	64%	33%	56%	11%	0%	0%
Safety Considerations in Route Selection/Scheduling	71%	70%	30%	0%	0%	0%
Special Traffic and Parking	71%	30%	60%	10%	0%	0%
Other	7%	100%	0%	0%	0%	0%

LEGEND	
USED	Used at System
HE	Highly Effective
ME	Moderately Effective
NE	Not Effective
DK	Don't Know
INC	Incomplete

summarizes the responses according to fleet size (small, medium, and large). A review of the data by fleet size indicates that for certain practices, there is a significant difference in both use and effectiveness ratings according to system size. For example, screening tests and driver training simulators show a substantial difference in use and effectiveness, as illustrated in Table B4.

There are several important observations from the data in Table B4. First is the dominant effect of small systems on the overall tabulations, because nearly 75 percent of the respondents were in that size category. This effect is only important when there are significant variations in the usage and effectiveness ratings, such as in Table B4.

Small systems are less likely to use screening tests than are the medium and large systems. The large bus systems believe that screening tests are highly effective (70 percent rated the practice highly effective), while the small and medium systems were much less certain of effectiveness (33 percent of each group rated the practice highly effective). It is likely that the larger systems view screening tests as a highly effective practice because they have to recruit and hire a much larger number of vehicle operators in a given period of time. An

TABLE B4 Use and effectiveness ratings for screening tests and driver training simulators

	All Systems		Small Systems		Medium Systems		Large Systems	
	USED	HE	USED	HE	USED	HE	USED	HE
Screening Tests	48%	38%	42%	33%	64%	33%	71%	70%
Driver Training Simulators	16%	40%	15%	30%	18%	50%	29%	75%

USED = Used at System
HE = Highly Effective

effective screening test will help the systems to quickly identify a pool of candidates for further evaluation.

The use of a driver training simulator is not widespread throughout the industry (16 percent of all systems used the practice), but there is a substantial increase in use from the small, to medium, to large systems. There is also a very sharp difference in the rankings of effectiveness, with 30 percent of the small system users of simulators rating the practice as highly effective, 50 percent of the medium system users rating the practice as highly effective, and 75 percent of the large system users rating the practice as highly effective. With this particular practice, the ratings are affected by a "Don't Know" response rate of 40 percent for the small systems and 17 percent for the medium systems. This response rate may be attributable to the fact that the driver training simulator technology is relatively new and that the smaller transit systems have had less experience with its use.

The above examples illustrate that, in certain cases, the tabulated responses from all systems may not accurately represent the use, effectiveness ratings, or both for the larger systems or, to a lesser extent, for the medium systems. This fact is due to the very large percentage of small systems (75 percent) in the total pool of respondents, as noted earlier.

The tabulated results for all systems show that there is a very wide range in the percentage of transit systems that use a particular practice. The lowest use percentage was 7 percent for black box recorders, while the highest was 98 percent for personal interviews. A low use rate may indicate that

- There is new technology involved that has not been widely disseminated in the transit industry,
- The practice may be too costly for the particular circumstances of the transit system, or
- The practice is not considered to be effective in preventing accidents.

There was also a fairly wide range for the effectiveness ratings for various practices: defensive driving had the highest "highly effective" rating, assigned by 68 percent of the users, whereas only 14 percent of the users of a math or reading test reported that practice to be highly effective.

Since there were four choices for effectiveness (i.e., highly, moderately, and not effective/don't know), one has to be careful when interpreting the effectiveness ratings. In most cases, a large proportion (i.e., 80 percent or more) of the systems that use a particular practice indicated that it was highly effective or moderately effective; therefore, the relative value for these two ratings provides a good indication of the overall effectiveness of the practices.

There are, however, some practices where the "not effective" and "don't know" responses were significant, which affects the interpretation of effectiveness. For example, the two practices with the highest not effective ratings are

- Incentive programs for management (15 percent use, and 15 percent of users rated the practice "not effective") and
- Special traffic and parking enforcement programs (32 percent use, and 12 percent of users rated the practice "not effective").

In both cases, these negative assessments reflect directly the overall effectiveness of the practice. The same is not true for the "don't know" responses, since such a response simply means that the respondent is uncertain about the proper effectiveness rating.

For example, the three practices with the largest "don't know" response are

- Black box recorder (7 percent use, and 67 percent of users rated the practice "don't know"),
- Driver training simulator (16 percent use, and 30 percent of users rated the practice "don't know"), and
- Map orientation test (29 percent use, and 19 percent of users rated the practice "don't know").

In this case, one has to examine all of the ratings in context to determine whether the practice is likely to become highly effective over time or whether it may be highly effective for a particular size of transit system. In the case of the driver training simulator, 40 percent of users assigned a "highly effective" rating, which is quite reasonable, considering that another 30 percent of the users answered "don't know." A more detailed examination of the response data by system size (see Table B3) shows that 70 percent of large transit systems that use driver training simulators assigned a "highly effective" rating, which is a very high effectiveness rating.

THE TOP TEN HIGHLY EFFECTIVE BUS ACCIDENT PREVENTION PRACTICES

Given all of the previous discussion, the top ten highly effective practices for all systems are as shown in Table B5.

Table B6 lists all practices in descending order of "highly effective" rating. Table B6 also contains separate ranked listings based on system size. With the exception of ramp entry–low floor bus, all of the highly effective practices noted in Table B5 are in use at a majority of the responding transit systems.

HIGHLY EFFECTIVE PRACTICES BY FLEET SIZE

A different picture emerges when the rankings of the top ten highly effective practices are compared for small, medium, and large transit systems, as shown in Table B7.

TABLE B5 Top ten highly effective bus accident prevention practices

No.	Practice	Percent Using	Percent Ranking Highly Effective
1	Defensive Driving	97%	68%
2	Driver Vision or Mirrors	79%	65%
3	Vehicle Safety Inspections	93%	60%
4	Safety Considerations in Route Selection or Scheduling	76%	59%
5	Personal Interviews	98%	53%
6	Doors and Door Controls	60%	52%
7	Ramp Entry-Low Floor Bus	26%	52%
8	Brake Lights or Warning Signs	69%	50%
9	Daytime Running Lights	58%	50%
10	Programs for "Accident Repeaters" Drivers	69%	49%

One of the most interesting observations from Table B7 is the fact that there is very little commonality of the highly effective practices. In fact, only the following practices were common either to all three groups of transit systems or to only two groups:

- Driver vision or mirrors (common to all systems),
- Vehicle safety inspections (common to all systems),
- Defensive driving (common to small and medium systems),
- Ramp entry–low floor bus (common to small and medium systems), and
- Safety considerations in route selection or scheduling (common to small and large systems).

Considering this commonality of certain practices, there are 23 independent accident prevention practices that can be considered as the most highly effective. These top practices cover all of the categories, as shown in Table B8.

There are several practices in the top 23 that are used at less than 50 percent of the respondent transit systems. These practices include, in ascending order of use,

- On-board surveillance cameras (22 percent of small systems use),
- Ramp entry–low floor bus (26 percent of small and medium systems use),
- Driver training simulator (29 percent of large systems use),
- Deceleration alert system (39 percent of medium systems use), and
- Bus stop maintenance (45 percent of small systems use).

In the previous list, all of the practices, with the exception of bus stop maintenance, involve relatively new technology, which is expected to evolve further and find greater acceptance and use in the transit industry. Therefore, the list of the 23 most effective practices is considered to represent a comprehensive combination of well established accident prevention practices and programs and evolving accident prevention technology solutions.

However, a comparison of Table B6 with Table B7 shows that the arbitrary cut-off caused by selecting the top ten practices in each fleet category leaves some very important practices out of the 23 most effective practices, including safety committee for accident review, system safety program, and bus turnouts and pullouts. The differences in effectiveness ratings are very small, generally only a few percentage points.

Such small differences are not significant, since the rating process using the request-for-information form is quite subjective. The person filling out the form is providing his or her opinion of the effectiveness of numerous accident prevention practices. It is easy to visualize a situation where one transit system may rate a practice as highly effective while another system would rate it as moderately effective, even

(*text continues on page B-34*)

TABLE B6 Ranking of highly effective accident prevention practices for bus systems

Part A: Based on responses from 182 small, medium, and large bus systems

Practice	Category	Highly Effective (of Systems Using)	Used at System
Defensive Driving	B	68%	97%
Driver Vision/Mirrors	F	65%	79%
Vehicle Safety Inspections	E	60%	93%
Safety Considerations in Route Selection/Scheduling	G	59%	76%
Personal Interviews	A	53%	98%
Doors and Door Controls	F	52%	60%
Ramp Entry-Low Floor Bus	F	52%	26%
Brake Lights/Warning Signs	F	50%	69%
Daytime Running Lights	F	50%	58%
Programs for “Accident Repeater” Drivers	E	49%	69%
Deceleration Alert System	F	49%	34%
Questionable/False Claims Program	E	49%	30%
Bus Stop Maintenance	G	48%	47%
Safety Committee for Accident Review	E	47%	75%
Pre-employment Physical	A	46%	92%
Emergency Procedures	B	46%	92%
System Safety Program	E	46%	76%
Passenger Training	D	46%	55%
On-Board Surveillance Cameras	F	46%	26%
Safety Audits of Bus Operations	E	45%	60%
Bus Bays	G	45%	57%
Bonuses/Prizes	C	45%	47%
Driver Workstation	F	44%	39%

(*continued on next page*)

TABLE B6 (Continued)

Practice	Category	Highly Effective (of Systems Using)	Used at System
Lighting	F	43%	57%
Bus Stop Design Guidelines	G	42%	49%
Stepwell Ice/Snow Removal	F	42%	40%
Safety Awards/Recognition	C	41%	85%
Bus Stop Location Guidelines	G	41%	65%
Computerized Database	E	41%	47%
Passenger Sensitivity	B	40%	90%
Driver Training Simulator	B	40%	16%
ADA-Related	B	38%	90%
Screening Tests	A	38%	48%
Ride Checks	E	37%	86%
Special Traffic and Parking	G	37%	32%
Perks/Privileges	C	37%	19%
Ed Programs for School Children	D	33%	60%
Incentive Programs for Management	E	30%	15%
Map Orientation Test	A	27%	29%
Customer Educational Programs	D	25%	42%
Black Box Recorder	F	17%	7%
Math/Reading Test	A	16%	28%

LEGEND	
A	Driver Selection & Hiring
B	Driver Training
C	Safe Driver Incentive Programs
D	Customer Safety Programs
E	Management Practices & Programs
F	Bus Technology Improvements
G	Operating Environment

TABLE B6 (Continued)

Part B: Based on responses from 135 small bus systems

Practice	Category	Highly Effective (of Systems Using)	Used at System
Defensive Driving	B	68%	96%
Driver Vision/Mirrors	F	64%	79%
Safety Considerations in Route Selection/Scheduling	G	63%	76%
Vehicle Safety Inspections	E	61%	94%
Daytime Running Lights	F	54%	55%
Personal Interviews	A	52%	99%
Bus Stop Maintenance	G	52%	45%
Ramp Entry-Low Floor Bus	F	51%	26%
Bonuses/Prizes	C	50%	50%
On-Board Surveillance Cameras	F	50%	22%
System Safety Program	E	49%	76%
Safety Committee for Accident Review	E	49%	76%
Doors and Door Controls	F	49%	60%
Deceleration Alert System	F	49%	33%
Questionable/False Claims Program	E	49%	29%
Brake Lights/Warning Signs	F	48%	66%
Programs for “Accident Repeater” Drivers	E	48%	61%
Safety Audits of Bus Operations	E	47%	56%
Bus Bays	G	47%	53%
Stepwell Ice/Snow Removal	F	46%	41%
Bus Stop Design Guidelines	G	45%	41%
Special Traffic and Parking	G	44%	25%
Pre-employment Physical	A	43%	93%
Safety Awards/Recognition	C	43%	81%

(*continued on next page*)

TABLE B6 (Continued)

Practice	Category	Highly Effective (of Systems Using)	Used at System
Driver Workstation	F	43%	34%
Bus Stop Location Guidelines	G	42%	63%
Passenger Training	D	42%	54%
Lighting	F	42%	53%
Emergency Procedures	B	41%	91%
Perks/Privileges	C	38%	19%
Ride Checks	E	37%	84%
Passenger Sensitivity	B	36%	87%
ADA-Related	B	33%	89%
Screening Tests	A	33%	42%
Computerized Database	E	33%	38%
Incentive Programs for Management	E	33%	16%
Ed Programs for School Children	D	32%	56%
Customer Educational Programs	D	30%	35%
Driver Training Simulator	B	30%	15%
Map Orientation Test	A	29%	26%
Black Box Recorder	F	18%	8%
Math/Reading Test	A	14%	26%

LEGEND	
A	Driver Selection & Hiring
B	Driver Training
C	Safe Driver Incentive Programs
D	Customer Safety Programs
E	Management Practices & Programs
F	Bus Technology Improvements
G	Operating Environment

TABLE B6 (Continued)

Part C: Based on responses from 33 medium bus systems

Practice	Category	Highly Effective (of Systems Using)	Used at System
Defensive Driving	B	73%	100%
Driver Vision/Mirrors	F	64%	76%
Emergency Procedures	B	61%	94%
Brake Lights/Warning Signs	F	59%	67%
Ramp Entry-Low Floor Bus	F	56%	27%
Deceleration Alert System	F	54%	39%
Passenger Sensitivity	B	53%	97%
ADA-Related	B	52%	94%
Vehicle Safety Inspections	E	52%	88%
Passenger Training	D	52%	64%
Personal Interviews	A	50%	97%
Doors and Door Controls	F	50%	61%
Driver Training Simulator	B	50%	18%
Pre-employment Physical	A	48%	88%
Computerized Database	E	46%	73%
Daytime Running Lights	F	45%	67%
Questionable/False Claims Program	E	45%	33%
Programs for “Accident Repeater” Drivers	E	43%	91%
Lighting	F	43%	70%
Ride Checks	E	39%	85%
Safety Considerations in Route Selection/Scheduling	G	38%	79%
Safety Committee for Accident Review	E	38%	79%
Bus Stop Maintenance	G	38%	48%
Bus Stop Design Guidelines	G	36%	67%
Safety Awards/Recognition	C	35%	94%

(*continued on next page*)

TABLE B6 (Continued)

Practice	Category	Highly Effective (of Systems Using)	Used at System
Ed Programs for School Children	D	33%	73%
Bus Bays	G	33%	64%
Screening Tests	A	33%	64%
Map Orientation Test	A	33%	36%
On-Board Surveillance Cameras	F	33%	36%
Perks/Privileges	C	33%	18%
Driver Workstation	F	31%	48%
Bonuses/Prizes	C	31%	39%
Bus Stop Location Guidelines	G	30%	70%
System Safety Program	E	29%	73%
Special Traffic and Parking	G	27%	45%
Math/Reading Test	A	25%	36%
Safety Audits of Bus Operations	E	24%	64%
Stepwell Ice/Snow Removal	F	18%	33%
Customer Educational Programs	D	13%	48%
Incentive Programs for Management	E	0%	6%
Black Box Recorder	F	0%	3%

LEGEND	
A	Driver Selection & Hiring
B	Driver Training
C	Safe Driver Incentive Programs
D	Customer Safety Programs
E	Management Practices & Programs
F	Bus Technology Improvements
G	Operating Environment

TABLE B6 (Continued)

Part D: Based on responses from 14 large bus systems

Practice	Category	Highly Effective (of Systems Using)	Used at System
Doors and Door Controls	F	78%	64%
Driver Vision/Mirrors	F	75%	86%
Driver Training Simulator	B	75%	29%
Screening Tests	A	70%	71%
Safety Considerations in Route Selection/Scheduling	G	70%	71%
Pre-employment Physical	A	69%	93%
Vehicle Safety Inspections	E	69%	93%
Programs for "Accident Repeater" Drivers	E	69%	93%
Safety Audits of Bus Operations	E	67%	86%
Driver Workstation	F	67%	64%
Computerized Database	E	64%	79%
Safety Committee for Accident Review	E	63%	57%
Personal Interviews	A	62%	93%
Questionable/False Claims Program	E	60%	36%
Defensive Driving	B	57%	100%
Passenger Training	D	57%	50%
Bus Bays	G	55%	79%
Bus Stop Location Guidelines	G	55%	79%
ADA-Related	B	54%	93%
System Safety Program	E	54%	93%
Brake Lights/Warning Signs	F	50%	100%
Emergency Procedures	B	50%	100%
On-Board Surveillance Cameras	F	50%	43%
Stepwell Ice/Snow Removal	F	50%	43%
Ramp Entry-Low Floor Bus	F	50%	29%

(*continued on next page*)

TABLE B6 (Continued)

Practice	Category	Highly Effective (of Systems Using)	Used at System
Ed Programs for School Children	D	44%	64%
Lighting	F	44%	64%
Passenger Sensitivity	B	43%	100%
Bus Stop Design Guidelines	G	42%	86%
Safety Awards/Recognition	C	38%	93%
Ride Checks	E	36%	100%
Bus Stop Maintenance	G	33%	64%
Perks/Privileges	C	33%	21%
Deceleration Alert System	F	33%	21%
Daytime Running Lights	F	30%	71%
Special Traffic and Parking	G	30%	71%
Incentive Programs for Management	E	25%	29%
Customer Educational Programs	D	23%	93%
Bonuses/Prizes	C	20%	36%
Map Orientation Test	A	0%	36%
Math/Reading Test	A	0%	29%
Black Box Recorder	F	0%	0%

LEGEND	
A	Driver Selection & Hiring
B	Driver Training
C	Safe Driver Incentive Programs
D	Customer Safety Programs
E	Management Practices & Programs
F	Bus Technology Improvements
G	Operating Environment

TABLE B7 Comparison of the top ten highly effective practices by transit system size

	Small (135 Systems)			Medium (33 Systems)			Large (14 Systems)		
	Practice	**% Using**	**% Highly Effective**	**Practice**	**% Using**	**% Highly Effective**	**Practice**	**% Using**	**% Highly Effective**
1	Defensive Driving	96%	68%	Defensive Driving	100%	73%	Doors and Door Controls	64%	78%
2	Driver Vision Mirrors	79%	64%	Driver Vision Mirrors	76%	64%	Driver Vision/Mirrors	86%	75%
3	Safety Considerations in Route Selection Scheduling	76%	63%	Emergency Procedures	94%	61%	Driver Training Simulator	29%	75%
4	Vehicle Safety Inspections	94%	61%	Brake Lights Warning Signs	67%	59%	Screening Tests	71%	70%
5	Daytime Running Lights	55%	54%	Ramp Entry-Low Floor Bus	27%	56%	Safety Considerations in Route Selection/Scheduling	71%	70%
6	Personal Interviews	99%	52%	Deceleration Alert System	39%	54%	Programs for “Accident Repeater” Drivers	93%	69%
7	Bus Stop Maintenance	45%	52%	Passenger Sensitivity	97%	53%	Pre-employment Physical	93%	69%
8	Ramp Entry-Low Floor Bus	26%	51%	ADA-Related	94%	52%	Vehicle Safety Inspections	93%	69%
9	Bonuses Prizes	50%	50%	Vehicle Safety Inspections	88%	52%	Safety Audits of Bus Operations	86%	67%
10	On-Board Surveillance Cameras	22%	50%	Passenger Training	64%	52%	Driver Workstation	64%	67%

TABLE B8 Distribution of highly effective practices by accident prevention category

Category		Number of Highly Effective Practices
A.	Driver Selection & Hiring	3
B.	Driver Training	6
C.	Safe Driver Incentive Programs	1
D.	Customer Safety Programs	1
E.	Management Practices and Programs	5
F.	Bus Technology Safety Improvements	11
G.	Operating Environment	3
	Total	30

though the accident statistics and trends for both systems are relatively comparable. This difference may simply be a matter of different perspectives on safety by the individual respondents.

Therefore, TMS believes that all of the practices and programs in Table B6, up to and including ride checks, should be considered highly effective practices.

The overall ranking of practices and programs for all 182 bus systems provides an in-depth, industrywide assessment of the relative importance of each of these practices in the overall safety programs of the transit agencies. Similarly, the rankings by fleet size provide an assessment of the relative importance of the accident prevention practices among the small, medium, and large fleet systems.

APPENDIX C

ACCIDENT PREVENTION PRACTICES AMONG TRANSIT INSURANCE POOLS

INTRODUCTION

In addition to the direct data collection from transit systems using the request-for-information form and follow-up telephone interviews, a separate effort was conducted to collect information about the accident prevention practices of transit insurance pools. The more precise term for this type of organization is a "risk retention pool." Risk retention pools are one of the three major options that transit systems have for risk financing (i.e., for paying for any liability, property damage, or other types of losses). The other two options are conventional insurance and individual transit system self-insurance.

A transit risk retention pool is a cooperative of several transit systems that agree to jointly fund particular types of losses. Participants contribute to the pool and, in turn, the pool pays losses. The pool typically handles the administrative functions, provides claims management, and promotes loss prevention. The pool retains losses up to a certain dollar level, with excess insurance often purchased by the pool for losses above this level.

The separate effort to collect information from transit risk retention pools was conducted by a TMS project team member with specialized expertise in the area of risk management for transit agencies—Mr. Michael Kaddatz. Mr. Kaddatz is the author of *TCRP Synthesis of Transit Practice 13*, "Risk Management for Small and Medium Transit Agencies." This TCRP synthesis is an excellent resource for more detailed information about risk management in the transit industry and the role of risk retention pools. The following discussion summarizes the information and data collected by Mr. Kaddatz through direct contacts with six statewide transit risk retention pools.

INFORMATION COLLECTED FROM RISK RETENTION POOLS

Transit operators in at least six states have collaborated to form risk retention pools to finance liability losses that arise from bus accidents. California, Michigan, Ohio, Virginia, Washington, and Wisconsin each have statewide risk retention entities, owned by participating transit systems, that provide liability insurance to the systems. The cost of the insurance mostly depends on the liability losses incurred. As owner-participants, each of the systems has a vested interest in reducing bus accidents. Accordingly, owner-participants have developed and supported techniques that promote safe bus operation.

Five of the pools provided operating information and data helpful to this study. Table C1 summarizes key operating data from the pools. While the information is useful to understanding the scope of the pools' operations, it should not be used by the reader to draw comparative conclusions among them. Each pool operates in a slightly different environment, with differing capital and reinsurance structures and unique procedures. These factors influence the data. For example, the relatively large number of accidents reported by the Wisconsin program is heavily influenced by that pool's emphasis on accident-reporting enforcement. So, too, a pool that has a high ratio of losses to contributions may be able to sustain the ratio, because its revenues are more heavily supplemented by interest earnings from its equity base than are revenues of other pools where the accumulated equity base is much lower.

Each of the pools is self-governed, with each participant having representation on the organization's governing board. Some have in-house staff, some are completely staffed by vendors, and others use a combination of in-house and outsourced services to conduct their day-to-day business. Except for the Michigan pool, each pool offers a limit of liability protection to participants that is higher than the risk retained by the pool (see Table C1). The pool provides the higher liability limit by purchasing conventional insurance or reinsurance from the commercial marketplace and passing on the cost to the pool's members that elect higher coverage.

All of the pools offer one or more coverages peripheral to bus liability coverage, including bus physical damage coverage (collision and comprehensive), general liability, and buildings and contents coverage. The data in Table C1 reflect only the bus liability coverage retained by the pool.

ACCIDENT PREVENTION PRACTICES

With losses being the primary determinant of contributions, pools are heavily motivated to prevent bus accidents. Generally, the longer they have operated, the more extensive the pools' accident prevention programs have become. Through the interviews with pool principals, it has been noted that the pools' approaches to loss prevention have evolved over time. They have employed some or all of the following techniques to encourage safe vehicle operation among their members:

- Inspections,
- Award programs,
- Roadeos,
- Reference manuals, and
- Seminars.

The pools' experience with these methods follows.

TABLE C1 Transit risk pool data summary

Name	Year Founded	Number of Participating Properties	Revenue Vehicles	Annual Miles (Millions)	Per-Accident Risk Retained by Pool	Liability Contributions (Millions)	Estimated Losses (Millions)	Reported Accidents per Year
California Transit Insurance Pool	1987	29	N.A.	30	$500,000	$2.15	$2.00	235
Ohio Transit Insurance Pool	1994	8	788	20	$250,000	$1.60	N.A.	N.A.
Michigan Transit Pool	1988	28	967	21	$1,000,000	$1.36	$1.17	250
Transit Mutual Ins. Co. of Wisconsin	1986	19	612	15	$1,250,000	$1.20	$0.87	725
Washington State Transit Insurance Pool	1989	14	1,464	35	$300,000	$1.58	$0.73	250

N.A. = Not Available

Inspections

Full-service commercial insurers have traditionally packaged safety inspection service with the coverage they provide. Generally, the larger policyholders (measured by premium size) receive more inspection services from the insurer. Insurers have traditionally staffed the inspection service with engineers. The core service consists of the safety engineer visiting the premises of the policyholder, viewing the physical hazards and operating environment, and preparing a written report containing recommendations aimed at reducing hazards or implementing practices that will mitigate the chance of an accident arising from the hazards.

In their initial years of operation, several of the pools reported they used inspections to

- Obtain a baseline of information about the hazards and risk-related operating practices of the participants and
- Recommend changes that would reduce the likelihood of accidents.

California, Michigan, and Wisconsin initially engaged insurance industry firms to perform the desired inspections. All three pools report disappointment with the services they received.

- The insurance industry inspectors tended to be generalists, not well versed in municipal transit operations and exposures.
- Costs of contracting for the services were substantial.
- Many of the recommendations focused on the system's base of operations and maintenance, not on-the-road exposures to loss.
- Recommendations often seemed oriented toward preventing employee injuries and did not address how to prevent liability accidents.

After these initial efforts, the pools revised their approach. California discontinued the inspection services. Michigan and Wisconsin discontinued the contract services and replaced them with inspections performed by informed staff of member systems. Knowledgeable about bus transit, these "in-house" teams developed inspection protocols and reports that responded meaningfully to the unique hazards of municipal transit. The pools found that their committees policed each other's system safety practices in ways that were more sharply critical and simultaneously helpful than any outside evaluation and report they had received in the past.

Awards Programs

Wisconsin has established a program whereby it recognizes transit systems that have superior records of performance. Under its driver incentive program, the pool divides its membership into three groups on the basis of annual mileage: small, medium, and large. Within each group, the pool keeps track of the number of accidents and miles for each transit property. At the end of a year, a winner is selected for each group. The winner has the lowest frequency of accidents. Each driver employed by the winning system receives a cash award. Such programs are employed in the other states at some of the individual systems and are encouraged by the involved pools. The goals of the award programs are to encourage safe driving; make it a part of the conscious thought process of all operators; and provide modest awards, cash, and recognition for operators and agencies that excel.

Roadeos

In several states, the state transit association or the department of transportation sponsors a roadeo—a series of events that test the skill of coach operators. In Wisconsin, the pool sponsors and organizes the roadeo. Using the spirit of friendly

competition, the goal of such events is to make superior bus-operating skills prominent in the minds of drivers, to bring recognition to individuals, and to motivate individuals who might otherwise allow their driving to deteriorate in the monotony of an everyday job.

Reference Manuals

Resources that support and promote bus accident prevention have not been readily available in the past. Two pools, in Michigan and in California, have invested substantial sums to develop comprehensive loss prevention reference manuals for their participants.

After Michigan's early dissatisfaction with insurance industry inspection services, it embarked on a multiyear process to develop a comprehensive approach to accident prevention. Using an internal team, the pool began inspections of its participants in 1989 to

- Establish a baseline of exposures to loss generated by its participants,
- Determine the loss prevention needs of its participants, and
- Identify best practices in loss prevention already employed by participants.

Early on, the team's specific recommendations for improved safety management were provided to participants. Over time, the team developed a comprehensive safety management manual, published in 1995. The manual contains text and forms that assist a transit manager, not schooled in risk management, in the development of a system safety program. The manual provides

- Hiring procedures and forms,
- Accident and incident reporting procedures and forms,
- Model contracts for subcontracting specialized transit services,
- Training tools,
- Driver incentive program models, and
- Much more pertinent reference material.

A special feature of the manual is a software package that allows the transit manager to perform a computerized risk assessment of his or her system.

The Michigan Transit Pool Risk Management Committee sells its two-volume manual, entitled *Practical Management of Safety for Michigan Public Transportation Systems,* for $300.00 plus shipping. For more information, contact the committee at (517) 787-8363.

California also developed a comprehensive safety management resource. The pool carefully crafted a request for proposals (RFP) that solicited proposals from vendors versed in safety management and bus transit. A vendor was selected to design a safety management program for the pool. In 1996, the selected vendor completed its research and design work and delivered the *CalTIP System Safety Program Model*©. The model design is illustrated in Figure C1. The model is now being field-tested at four properties before it is endorsed or released to the entire membership.

Seminars

All of the pools support, if not provide, educational opportunities in safety management for their participants. Ohio provides periodic seminars for its transit managers and staff. Topics at such seminars include

- Driver hiring and dismissal,
- Labor-negotiating techniques,
- Ghost riding and other quality-assurance techniques,
- Driver incentive and penalty systems, and
- Defensive driving.

The Ohio pool has recently invested in software and hardware for its participants. The software and hardware will permit all drivers to be trained on defensive driving techniques each year.

MEASURING EFFECTIVENESS

The pools have more data pertinent to bus accidents than perhaps any other source does. Each pool has an automated database on losses and accidents. This database records

- Accident date, time, and location;
- Accident cause and description;
- Driver name, equipment involved, and service type; and
- Amount spent and reserved for the defense and settlement of the loss.

The pools also maintain data on the operating characteristics of their members, vehicle-by-vehicle fleet descriptions, miles, boardings, and location.

To date, the pools have used the data to measure overall accident rates, develop contribution rates, and otherwise manage the essential financial affairs of the pools. However, there was no effort on the part of the pools to measure the effectiveness of any specific loss prevention technique. There are a number of possible reasons for the lack of effectiveness measurements, including the following.

- The software and data management mechanisms employed have not been sophisticated enough to support the suggested analyses.
- The size of each database on its own is relatively small for reaching a conclusion on loss prevention technique effectiveness.
- The dynamic environments in which the pools operate make it difficult to know if a change in loss trends is due to a safety technique, a shift in public attitudes toward litigation, weather patterns, random luck, or some other factor.

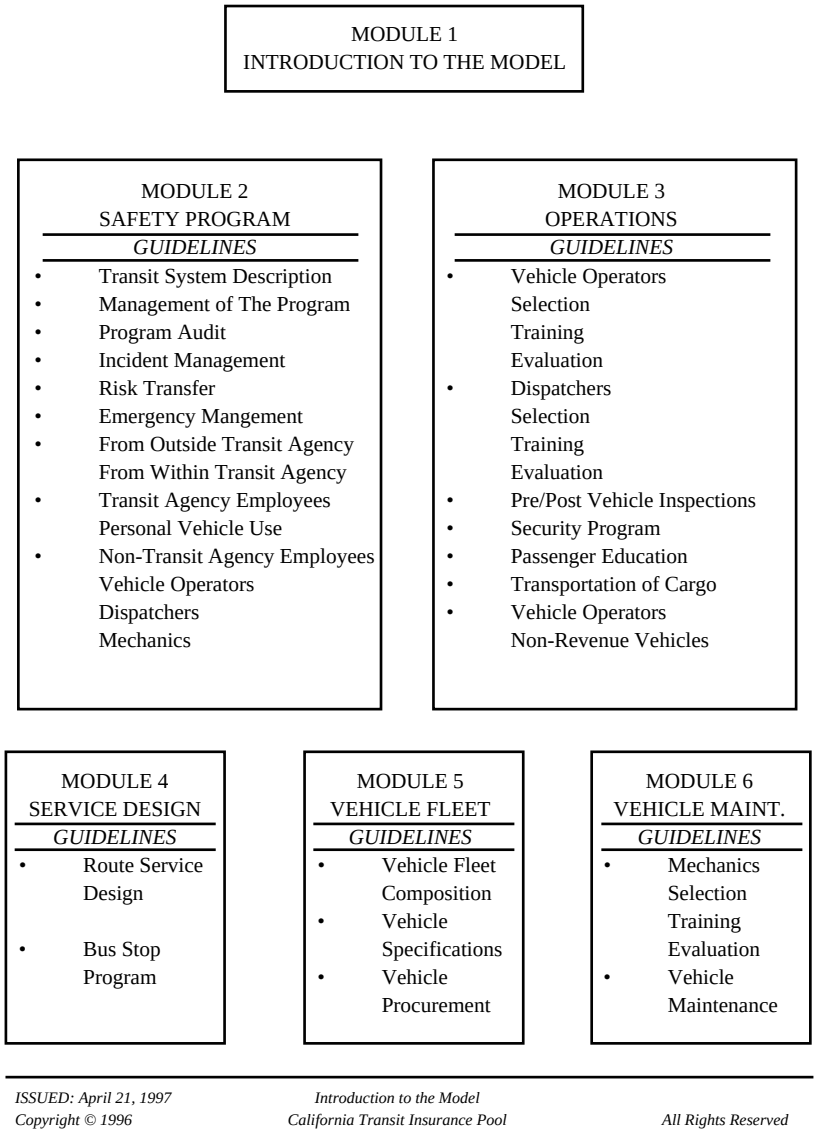

Figure C1. CalTIP system safety program model.

- Pool management tends not to micromanage the safety efforts of members.

ACCOUNTABILITY

A key goal of all pools is to achieve financial equity among the members, so that none feel they are paying a disproportionate share of the pool's losses and operating expenses. Many factors affect the losses any particular member has. Together, these factors represent a participant's exposure to loss. Some of the factors that influence the exposure are

- The types and sizes of vehicles in the fleet;
- The affluence of the passengers and the community in general;
- The mix of service among urban, suburban, and rural;
- The effectiveness of loss prevention practices employed;
- The social attitudes toward litigation that exist in a given community; and
- Road and weather conditions.

Since all of these factors vary, it is inequitable to charge each member the same rate within a pool. Yet it is impossible to measure the influence on relative risk each factor presents on each pool member. To resolve this dilemma, pools have used various techniques in calculating premiums that establish an individual system's loss experience as a key determinant of its ultimate pool contribution. The rationale is that, sooner or later, the six previous factors and other factors will ultimately appear in a member's good or bad loss record.

Some of the pools use deductibles to apply loss responsibility to the members. The more accidents a member has, the

more losses it will have to pay under the deductible. The amount of any loss over the deductible is often spread over the group on some basis like miles, vehicles, boardings, or some combination of the three. Thus, the individual system is penalized somewhat by the deductible, but protected from severe financial dislocation for the truly large loss.

Another technique to give participants loss responsibility is experience rating. Under this approach, the pool

1. Calculates its average rate of loss (e.g., per mile),
2. Looks at the individual loss histories (to 5 years) of its participants,
3. Compares the individual histories with the group's average, and
4. Charges the good performers less and the bad performers more on the basis of the comparison.

Experience rating formulas vary among the pools. Some have their roots in insurance industry mechanisms, and others are totally homegrown by the participating transit managers. As long as all believe they are equitable, they will produce the right result.

The pool contribution formulas would appear to produce overall equity. The pool safety management activities provide useful resources to transit managers. However, pool databases and management techniques have not been developed to display the most effective safety practices.

EXAMPLES OF TRANSIT POOL ACTIVITIES

The following descriptions provide a more comprehensive picture of the safety and loss prevention activities of two statewide risk retention pools (Wisconsin and Washington). The examples help to illustrate activities that have proven to be most beneficial to the member transit systems over the years.

The Wisconsin pool, Transit Mutual Insurance Company of Wisconsin, established loss prevention as a serious priority in the early stages of the program's existence. A subsidiary of the insurance broker that placed reinsurance for the pool was engaged to provide safety audits. The audits were performed over a year-and-a-half period on the 15 participating systems. The pool was disappointed in the audit results, citing the following reasons.

- The audits were boilerplate reviews, not true audits of transit system safety.
- The audits were not specific as to hazards and safety issues of public transit operators.
- The auditors were engineers, with some credentials in safety, but little or no training or experience with transit entities.
- Audit recommendations were few, not customized to the individual property, and not directed at the practices that would most ensure safe bus operation in the field.

The pool abandoned the contract audit approach and replaced the approach with programs that were designed and staffed mostly by the pool's safety committee. The committee comprised representatives from a cross section of the participating transit systems. Committee members were not safety or risk management professionals, but had first-hand experience with bus transit system operations. The committee decided to promote programs that encouraged safety at the driver level. Key programs designed and implemented by the committee are the following.

- **Driver incentive program.** Cash awards are paid to all drivers of the systems that have the lowest accident frequency rates. Awards are given to the systems, in each of three size categories determined by miles operated, that have the fewest accidents per miles driven. In addition, a pool-sponsored system of awarding patches and pins to all drivers in all participating systems acknowledges accident-free driving records of individual coach operators. The pool reports that the competition is keen and has gained the attention of everyone, from the transit system manager to the coach operator.
- **Safety audit.** Using a six-page checklist developed by the committee, the committee audits each of the pool participants at least once every other year. The audit protocol was enhanced from its initial design with field ride checks to detect compliance departures from recommended coach operator practices. The committee members staff this audit function. Recommendations are advisory, but because they carry the peer pressure of having originated from other program participants, they are routinely complied with.
- **Bus roadeo.** The pool organizes and staffs a statewide competition for bus operators annually. Competition is conducted in two divisions. First, second, third, and top rookie awards are given in each division. Again, the competitive environment fosters keen interest at the transit system in safe vehicle operation that carries forward throughout the year.
- **Training.** The pool sponsors and helps finance participation in several safety-related activities, including management and supervisor training, hands-on accident investigation, hands-on wheelchair training, and defensive driver instructor training.

The pool cannot determine which of its practices are the most effective at preventing bus accidents. Pool management believes the combination of focusing on the drivers and fostering the feeling of competition among drivers and systems is the key to keeping safety in the conscious mind of the transit system staff.

The Washington State Transit Insurance Pool was formed in 1989 and did little to address safety in its first 4 years of operation. Then, in 1993, it hired a full-time director, who

began addressing safety issues. Two years later, the pool hired a safety program manager to work full-time on loss prevention issues.

The key elements of the pools safety program to date are the following.

- **Safety manual.** An independent contractor was engaged to prepare a safety manual. The initial manual was designed to provide the participating systems with the features of safety that would allow the systems to meet regulatory standards for a public transit system. The manual concentrated on what end was needed, not on how to achieve that end. More recently, the safety program manager has set about enhancing the manual with policies and procedures that deal with how to reach safety standards. The program manager is also customizing the original manual to the unique characteristics of each transit system.
- **Website.** The most unique feature of this pool's approach to safety is the establishment of a pool website. The site supports several objectives:
  - **Claim reporting.** Claim reporting forms can be filled out electronically and are instantly received by the pool. One of the key aspects of loss control is prompt response to incidents.
  - **Insurance certificates.** When a member needs a certificate of insurance for a business situation, the member can request the certificate and receive the response via the website.
  - **Benchmarking.** The participant can access its accident data and compare them with data from other systems in the pool.
  - **Training and program development.** As the pool develops more practices and techniques that promote safe vehicle operation, it posts the results on the website for use by participants.
- **Train the trainer coalition.** In cooperation with the state transit association and the Washington State Department of Transportation, the pool helps participants develop in-house training capabilities on risk management and general management topics.
- **Annual awards.** The pool recognizes the best performing systems, in terms of accident rates, with annual awards.

The pool has not identified one or more specific safety activities that are more effective than others are.

APPENDIX D

ACRONYMS AND ABBREVIATIONS

AC Transit: Alameda–Contra Costa Transit (in Oakland, California)
ADA: Americans with Disabilities Act
AIT: Accident Investigation Team (RTD's)
APTA: American Public Transportation Association
AVL: automated vehicle location
BC Transit: British Columbia Transit
BOSS: Buss Operator Selection Survey (U.S.DOT's)
CalTIP: California Transit Insurance Pool
CCTV: closed-circuit television
CDL: commercial driver's license
CDTA: Capital District Transportation Authority (in Albany, NYS)
County Connection: Central Contra Costa Transit Authority (in California)
CTA: Chicago Transit Authority
CUTS: City Utilities of Springfield (in Missouri)
DAS: deceleration alert system
DDC: defensive driving course
DDC-PC: Defensive Driving Course–Personal Computer (PDA's)
DDW: defensive driving workshop
DRI: Driver's Risk Index
DTA: Duluth Transit Authority (in Minnesota)
DW: driver workstation
FTA: Federal Transit Administration
FTE: full-time equivalent
GCRTA: Greater Cleveland Regional Transit Authority
GPA: grade point average
ICC: Interstate Commerce Commission
LED: light-emitting diode
LFB: low-floor bus
LMB: large motor bus
MARTA: Metropolitan Atlanta Rapid Transit Authority (in Georgia)
Metro Transit: King County Metro Transit (in Seattle)
MMB: medium motor bus
MTA: Metropolitan Transportation Authority (in Los Angeles)
MTA-LI: Metropolitan Transit Authority–Long Island
MTD: Metropolitan Transit District
NHRC: New Hire Refresher Course (Pierce Transit's)
NJ Transit: New Jersey Transit
NSC: National Safety Council
NTD: National Transit Database (FTA's)
NYS: New York State
OCTA: Orange County Transportation Authority (in California)
PDA: Professional Development Associates
PTI: Pennsylvania Transportation Institute
PTS: Phoenix Transit System
PTSB: Public Transportation Safety Board (in NYS)
REI: Radio Engineering Industries, Inc.
RRTA: Red Rose Transit Authority (in Lancaster, Pennsylvania)
RTA: Regional Transit Authority (in Worcester, Massachusetts)
RTC: Regional Transportation Commission (in Reno, Nevada)
RTD: Regional Transportation District (in Denver)
SAMIS: Safety Management Information Statistics
SEPTA: Southeastern Pennsylvania Transportation Authority
SMB: small motor bus
SSP: system safety program
SSPP: system safety program plan
TARTA: Toledo Area Regional Transit Authority (in Ohio)
TMS: Technology & Management Systems, Inc.
TSI: Transportation Safety Institute (U.S.DOT's)
U.S.DOT: United States Department of Transportation
UTA: Utica Transit Authority (in NYS)
VMT: vehicle-maneuvering trainer
VHS: video home system
WMATA: Washington Metropolitan Area Transit Authority (in Washington, D.C.)

The **Transportation Research Board** is a unit of the National Research Council, which serves the National Academy of Sciences and the National Academy of Engineering. The Board's mission is to promote innovation and progress in transportation by stimulating and conducting research, facilitating the dissemination of information, and encouraging the implementation of research results. The Board's varied activities annually draw on approximately 4,000 engineers, scientists, and other transportation researchers and practitioners from the public and private sectors and academia, all of whom contribute their expertise in the public interest. The program is supported by state transportation departments, federal agencies including the component administrations of the U.S. Department of Transportation, and other organizations and individuals interested in the development of transportation.

The National Academy of Sciences is a private, nonprofit, self-perpetuating society of distinguished scholars engaged in scientific and engineering research, dedicated to the furtherance of science and technology and to their use for the general welfare. Upon the authority of the charter granted to it by the Congress in 1863, the Academy has a mandate that requires it to advise the federal government on scientific and technical matters. Dr. Bruce M. Alberts is president of the National Academy of Sciences.

The National Academy of Engineering was established in 1964, under the charter of the National Academy of Sciences, as a parallel organization of outstanding engineers. It is autonomous in its administration and in the selection of its members, sharing with the National Academy of Sciences the responsibility for advising the federal government. The National Academy of Engineering also sponsors engineering programs aimed at meeting national needs, encourages education and research, and recognizes the superior achievements of engineers. Dr. William A. Wulf is president of the National Academy of Engineering.

The Institute of Medicine was established in 1970 by the National Academy of Sciences to secure the services of eminent members of appropriate professions in the examination of policy matters pertaining to the health of the public. The Institute acts under the responsibility given to the National Academy of Sciences by its congressional charter to be an adviser to the federal government and, upon its own initiative, to identify issues of medical care, research, and education. Dr. Kenneth I. Shine is president of the Institute of Medicine.

The National Research Council was organized by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purpose of furthering knowledge and advising the federal government. Functioning in accordance with general policies determined by the Academy, the Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in providing services to the government, the public, and the scientific and engineering communities. The Council is administered jointly by both the Academies and the Institute of Medicine. Dr. Bruce M. Alberts and Dr. William A. Wulf are chairman and vice chairman, respectively, of the National Research Council.

Abbreviations used without definitions in TRB publications:

AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
FAA	Federal Aviation Administration
FHWA	Federal Highway 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
SAE	Society of Automotive Engineers
TCRP	Transit Cooperative Research Program
TRB	Transportation Research Board
U.S.DOT	United States Department of Transportation

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