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IDENTIFICATION AND TESTING OF COUNTERMEASURES FOR SPECIFIC ALCOHOL ACCIDENT TYPES AND PROBLEMS, VOLUME III: THE HEAVY TRUCK ALCOHOL PROBLEM

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Government Sponsors' Addendum

The Volume I report summarizes work conducted on a study to identify and test promising countermeasures for specific kinds of alcohol related accidents. During this study, two experiments--described more fully in Volume 2--were conducted to test the effects of selected roadway countermeasures on the driving behavior of motorist-subjects who either were sober or had been drinking. In addition, literature and accident data on the magnitude and nature of alcohol involvement in drivers of heavy trucks were examined and described in a separate volume (Volume 3).

Experiment I

Experiment I was designed to determine the effect of rumble strips and raised lane delineators on measures of driver performance (e.g., speed and lane position control) for drivers who were sober or had been drinking. An instrumented vehicle driven over a closed course was used. Due to problems listed below, the reader is cautioned about accepting the contractor's conclusion that: "The overall evidence supporting the effectiveness of the rumbling treatments was positive although not strong." (Volume 2, page 191)

- Although there was one anecdotal report of a driver losing control of his vehicle after contacting the rumbling treatment, no formal data were collected or presented on such occurrences. For example, no data were presented on whether drivers "overcorrected" after contacting the rumbling treatment and drove into an opposing lane of traffic.

- Examination of Volume 2, Table 16 indicated that more rather than less lane deviations occurred in the presence of the rumbling treatments when subjects were sober. An adequate explanation of this unexpected negative finding was not presented.

Experiment II

Experiment II used a driving simulator to evaluate the effects of continuous treatments (standard and wide edgelines) and spot treatments at curves (e.g., post delineators, flashing beacons added to curve warning signs), on the driving behavior of subjects who had been drinking. In spite of positive results for edgelines (i.e., a reduction in several measures of alcohol impairment of between 30 and 46 percent for subject-motorists at the highest alcohol level), the contractor did not recommend implementation of the edgeline countermeasure nor even that additional research be conducted. Based on the results of this study, further examination of this potential countermeasure is warranted. It should be noted that the FHWA is currently conducting a research study designed to examine the effects of standard and wide edgelines on the accidents of drinking and non-drinking motorists.

The reader is cautioned about interpreting results from a number of tables presented in Volume 2. Tables 42-44 and 46, 47 (as summarized in Table 48) in Volume 2 are incomplete as only "significant two-way interactions" are presented. Other more complex effects among the six factors investigated were not presented. As an hypothetical example, if each of two types of roadway countermeasures (e.g., edgeline presence and post delineators) did not dramatically reduce the amount of weaving for drinking drivers, but

their combination did, this finding would not have been presented.

Fatigue

The contractor recommended (Volume 2, page 194), that studies of accident data be conducted "... to determine if fatigue-related accident types can be identified." However, the findings from this study do not support a fatigue effect. First, only behavioral data (e.g., on vehicle position, speed) were obtained, analyzed and reported. Information on whether or not subjects were, in fact, tired was not collected, and information on heart rate, and EEG to measure the subjects state of arousal, although collected in Experiment I, were found to be too variable for use. Second, the effects of "fatigue" appeared to yield different kinds of results in the two studies. For example, in Experiment I, examination of Figures 17 and 18 shows a reduction in mean velocity (speed) for both straight and curved roadways during the second hour (segments 3 and 4). On the other hand, curve entry speeds increased during the second hour in Experiment II (Table 58). In addition, an overall measure of driving performance (i.e., pay) increased during the second hour in Experiment II. Thus, the data from this study do not suggest a fatigue-related accident type.

Heavy Truck Alcohol Problem

The Volume 3 report presents information pertaining to the magnitude and nature of the heavy truck alcohol problem. As indicated by the contractor (Volume 3, page 1), this report was largely completed by 1979. Since that time, the National Center for Statistics and Analysis has published reports* containing more recent FARS data regarding alcohol involvement in heavy truck accidents. The reader should be aware that there are data that support the contractor's findings regarding the magnitude of the problem. (The May 1984 report contains data that are nearly identical in magnitude to those reported in Volume 3, Table 13, for the High Test States.)

The reader should be cautious when making comparisons among various study findings in Section 2 of the report as it appears that the definition of "heavy truck" may have differed from study to study. For example, on page 23, the FARS definition of heavy truck--i.e., single unit vehicles above a given weight and all multi-unit trucks--was different from the one used in the Baker study and Simpson study, i.e., tractor-trailers only.

*Alcohol Involvement in Traffic Accidents: Recent Estimates from the National Center for Statistics and Analysis DOT-HS-806-269, NHTSA Technical Report, May 1982, page A3.

Fatal Accident Reporting System 1982: An Overview of U.S. Traffic Fatal Accident and Fatality Data Collected in FARS for the Year 1982. DOT-HS-806-566, May 1984, page 17 - Figure 6.

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15. Supplementary Notes
The final report is in four volumes: Volume I is an Executive Summary. Volumes II and IV report on the general driver alcohol problem and the experimental evaluation of selected countermeasures.

16. Abstract

This report summarizes the results of work conducted during 1979 pertaining to the scope and nature of the heavy truck alcohol problem. Included is a review of literature available at that time, a detailed examination of the Fatal Accident Reporting System (FARS), and an examination of prospective countermeasure concepts to address the problem.

The search of literature and other informational sources revealed that rather little was available on the scope or nature of the drinking-driver problem among heavy truck drivers. Studies using police reports indicated that about two percent of the accident-involved truck drivers were alcohol-impaired while studies using blood tests and small samples indicated that 25-33 percent of fatally injured truck drivers had positive blood alcohol concentrations (BACs). Using FARS data from nine states where at least 80 percent of fatally-injured drivers are routinely tested for alcohol presence, 19 percent of the truck drivers had positive BACs. Regarding accident types, single-vehicle, road departure accidents, often at night, were found to be predominant for drinking truck drivers.

Countermeasures examined include in-vehicle devices to monitor driving performance and provide feedback or warning information to the driver and deterrent approaches such as use of the Bureau of Motor Carrier Safety (BMCS) regulatory structure to detect impaired drivers. Feasibility determination was limited because of the lack of appropriate data defining the problems and the specific individuals involved. Suggestions for future data collections are presented.

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FOREWORD

This report presents the results from a study conducted by Calspan Field Services, Inc. (CFSI) for the National Highway Traffic Safety Administration under contract DOT-HS-9-02085 entitled Identification and Testing of Countermeasures for Specific Alcohol Accident Types and Problems.

Phase I of the study included a review of available literature and data which pertain to the problem of alcohol use among drivers of heavy trucks. This work was directed by Dr. Kenneth W. Terhune of CFSI's Accident Research Division. Sections 2 and 3 of this report, as well as the appendices were originally presented in an interim report which was submitted to NHTSA in January 1980. Sections 4 and 5 report work conducted in Phase II of the study, which was directed by Mr. Thomas A. Ranney of CFSI. Messers. Perchonok (deceased) and Pollack of the Institute for Research, State College, Pennsylvania, contributed to Phase I of the study.

TABLE O CONTENTS

LIST OF TABLES

1. INTRODUCTION

This report presents information pertaining to the scope and nature of the heavy truck alcohol problem as revealed through a review of available literature and a detailed analysis of data from the Fatal Accident Reporting System (FARS). These tasks were conducted as part of Phase I of contract DOT-HS-9-02085 during 1979. It is important to note that the relative emphasis given to the heavy truck alcohol problem changed over the three phases of the contract. In the problem identification phase (Phase I), a significant amount of effort was directed toward determining the magnitude and scope of the heavy truck alcohol problem. The results of this effort are presented in Sections 2 and 3 of this report. However, because the available information was determined to be insufficient for establishing precisely the magnitude of the problem, and because what information was available suggested that the specific problems experienced by alcohol-impaired heavy truck drivers were no different from those associated with drinking drivers in general, it was decided to consider the heavy truck alcohol problem within the context of the general driver alcohol problem. It is also important to note that because the work reported in this volume was completed largely during 1979, the results may be considered somewhat dated. To the extent that alcohol reporting practices or accident data quality may have improved in the interim, this may well be true. If so, an update of this work would be warranted, and is recommended.

Section 4 of this report presents ideas identified during the course of the study which may be applicable to the heavy truck alcohol problem. The uncertainty about the magnitude and scope of the problem revealed through Phase I analyses made it especially difficult to establish priorities and specific recommendations. Suggestions for further research and development are presented in Section 5 of the report. When sufficient data or further analyses of existing data become available for use in establishing priorities, the suggested measures may lead to more specific recommendations.

2. MAGNITUDE OF ALCOHOL USE AMONG HEAVY TRUCK DRIVERS

2.1 Introduction

Whereas the role of alcohol as a causal factor in traffic accidents has been a topic of continuous and increasing concern, its use by drivers of heavy trucks has not been thoroughly studied. Interest in the problem of alcohol use by heavy truck drivers arose in response to a study by Baker (1975) which concluded that not only is there a significant alcohol problem among accident-involved heavy truck drivers, but also that police reports of alcoho involvement in heavy truck accidents are misleadin; due to substantial under-reporting of alcohol use (Baker, 1975).

Concern over the use of alcohol by heavy truck drivers has been expressed in several ways.

1) Because heavy trucks generally cover many more miles than passenger cars, and because of the documented seriousness of the consequences of heavy truck accidents, particularly to occupants of other vehicles, the use of alcohol by heavy truck drivers is considered to represent a more serious problem than use by other motorists.

2) Because in addition to state laws concerning drinking and driving, heavy trucks engaged in interstate commerce are subject to Federal Bureau of Motor Carrier Safety (BMCS) regulations which prohibit alcohol use, the use of alcohol by heavy truck drivers is considered to be a more serious offense than use by other motorists, more akin to drinking in the workplace.

For these reasons, this report examines both the magnitude and nature of alcohol use among heavy truck drivers. The topics were explored for accident and non-accident-involved heavy truck drivers. The findings presented herein represent the information obtained through literature searches, additional analyses of existing data, and discussions with knowledgeable individuals, within the various sectors of the trucking industry.

2.2 Published Reports

The published reports which address the use of alcohol by heavy truck drivers can be categorized according to the source of the information from which alcohol use is determined. The two major categories are studies which used police-reported drinking, and those which used the results of chemical tests for determining alcohol use. In addition, the NHTSA-maintained FARS data set uses information from both police reports and the results of chemical tests performed primarily on fatally injured drivers. Finally, the data submitted to the Bureau of Motor Carrier Safety (BMCS) of the Federal Highway Administration (FHA) relies on information provided by the carrier or independent operator to determine alcohol use by the accident-involved heavy truck driver. Because the BMCS data represents the most complete source of heavy truck accident information (Forsythe, et al., 1975), it will serve as a starting point in the discussion of available literature.

BMCS data. According to Federal Motor Carrier Safety Regulations*, motor carriers of property engaged in interstate commerce, foreign or interstate

* Title 49, Chapter III, Subchapter B

operations subject to the Department of Transportation Act, are required to submit accident reports for each involvement which results in (1) death, (2) injury which requires transport to medical facilities, or (3) property damage of $2,000 or more. From the 1977 BMCS analysis of accident data, Table 1 presents the number of accidents reported to BMCS along with the number of fatalities and injuries (BMCS, 1977).

TABLE 1

BMCS Reported Accidents, Injuries, Fatalities

(BMCS, 1977)

	1973	1974	1975	1976	1977
Accidents	30,911	25,358	24,274	25,666	29,936
Fatalities	3,058	2,429	2,232	2,520	2,983
Injuries	35,245	26,911	26,374	26,794	31,698

Of the 29,936 BMCS reported accidents which occurred in 1977, drinking was reported in 145 (0.5%). Dozing at the wheel was reported in 488 (1.6%).* The corresponding percentages reported for 1973 were 0.6% for drinking and 1.8% for dozing (BMCS, 1975). According to BMCS publications, therefore, the overall magnitude of drinking and dozing involvement in heavy truck accidents has decreased slightly between 1973 and 1977. For both years, dozing was reported approximately three times as often as drinking (BMCS, 1975; 1977).

Table 2 presents comparisons of the severity of BMCS reported accidents involving drinking and dozing.

*When available, the frequency of dozing will be presented for comparison with the frequency of alcohol use. This is because without objective information concerning alcohol presence, the behavioral effects of fatigue can be easily confused with those associated with alcohol impairment. Furthermore, it can be speculated that investigating officers may incorrectly report apparent drowsiness when alcohol was involved.

TABLE 2

BMCS Accident Severity, 1977 Accidents

(BMCS, 1977)

	Accidents		Fatalities		Injuries		Property Damage Costs ($000's)	
	N_A	Percent of All Accidents	N_F	Percent of All Fatalities	N_I	Percent of All Injuries	Costs	Percent of All Property Damage
Drinking	145	0.5	19	0.6	163	0.5	$ 2,120	0.9
Dozing	488	1.6	58	1.9	488	1.5	$ 8,783	3.6
Other Causes	29,303	97.9	2,906	97.4	31,047	98.0	$233,097	95.5
TOTAL	29,936	100.0	2,983	100.0	31,698	100.0	$244,000	100.0

According to these data, the BMCS-reported collisions involving alcohol resulted in .6% of all fatalities, .5% of all injuries, and .9% of all reported property damage. Dozing related accidents, similarly, were associated with 1.9% of the fatalities, 1.5% of the injuries, and 3.6% of all property damage.

FARS data. The magnitude of the drinking problem in heavy-truck accidents was also addressed by NHTSA, which published a special report of analysis of FARS data for heavy trucks (Cassidy, 1978). Data from 1975 and 1976 were analyzed in this report. It was reported that in 1976, 3,338 accidents resulted in 4,034 fatalities (1.21 fatalities/fatal accident). The corresponding frequencies for 1975 are 2,858 accidents and 3,487 fatalities (1.22 fatalities/fatal accident).

The FARS data analysis presents frequencies of the main contributing factors for truck drivers involved in fatal accidents. These data are presented in Table 3.

TABLE 3

Driver Factors from FARS Data

(Cassidy, 1978)

Main Contributing Factor for Truck Driver	N	%
Driving too fast	604	10.4
Drowsy or inattentive	262	4.5
Drinking	118	2.0
Driving on wrong side of road	116	2.0
Failure to keep in lane	200	3.5
None	3,540	61.2
All other factors	804	13.9
Unknown	137	2.4
TOTAL	5,781	100.0

Although the FARS data set does include the results of chemical testing, the report from which Table 3 was extracted indicates that the proportions of drinking and drowziness are based upon police reports (Cassidy, 1978). As indicated, drinking as a contributing factor was reported in two percent of the 5,781 fatal accidents involving a heavy truck. Inattention or drowziness contributed to 4.5 percent of the accidents.

These proportions can be compared with the BMCS data by selecting the subset of BMCS reported accidents which resulted in a fatality. According to Table 2, 19 heavy truck drivers involved in fatal accidents were reported to have been drinking. Since there were 2,293 fatal accidents, assuming one heavy truck per accident, the corresponding proportion of alcohol involvement for heavy truck drivers involved in fatal accidents is .8 percent (19/2,293), which is less than half the proportion reported by Cassidy (1978). This

difference suggests that in addition to any underreporting of alcohol involvement by the police*, the BMCS data itself underrepresent the involvement of alcohol in fatal heavy truck accidents.

Other reports using police data. In addition to the analyses of BMCS and FARS data, several analyses of heavy truck accidents have presented data concerning the proportion of alcohol involvement in heavy truck accidents using primarily police reported drinking involvement. Using police reports from 10 states, Ernst and Ernst (1968) conducted an analysis of approximately 9,000 sampled accidents each of which was selected for having involved one truck (of any size). With one exception, all accidents occurred in 1965. Of the 9,102 involvements, 2,146 (23.6%) tractor-trailers were involved, and 177 (1.9%) tractors with two trailers were involved. Cautioning the reader about the reliability and consistency of the police-reported drinking involvement, Ernst and Ernst presented the incidence of drinking drivers by vehicle type. Their table is reproduced below:

TABLE 4

Drinking Involvement by Vehicle Type

(Ernst and Ernst, 1968)

Type of Vehicle	Reported Drinkers (Percent)
Passenger car	6.1
Pickup truck	10.8
Panel truck	3.8
Straight truck	3.7
Tractor-trailer	2.0
Tractor-2 trailer	0.6
Other	1.2
Overall	5.5

* The question of police underreporting is discussed in the following section.

The combined drinking incidence of all tractor-trailer combination drivers is 1.9%, which is consistent with Cassidy (1978).

An analysis of heavy truck accidents which occurred in 1975-1976 in two geographically separated highway patrolled areas of California was conducted by the Traffic Safety Center at the University of Southern California at Los Angeles (Philipson, et al, 1978; Fleischer, 1979; USC, 1975). During a 12-month period, 3,022 accidents were included in the analysis. For this study, police-accident reports were supplemented with the commercial vehicle accident report supplement (CVARS), which provided detailed information about the load type, equipment condition, and driver factors. The following table presents the percentages associated with the most frequently occurring driver failures found in the sample. (The conditions were reported only when they either caused the accident or contributed to its severity.)

TABLE 5

Driver Failures Contributing to Accident Involvement

(Fleischer, 1979)

Cause of Failure	Drivers (%)
Fatigue	2.2
Excessive driving time	0.3
Drugs or alcohol	1.0

For the drivers of non-commercial vehicles involved in the same set of collisions, "alcohol, drugs, or physical impairment was involved in about 7 percent of the cases; alcohol predominated." (Fleischer, 1979, p. 32).

Using police-reported accident data collected during 1973, Lohman and Waller (1975) conducted an analysis of the characteristics of truck accidents in North Carolina. This sample included 5,653 large trucks, which included tractor-trailers and three-axle trucks; 29,076 two-axle trucks, and

218,730 autos. The accident characteristics of large trucks were determined by comparing frequency distributions of the major vehicle types. Among the major findings was the fact that larger trucks were more likely to be involved in single vehicle crashes than were cars or smaller trucks. Concerning driver conditions, the following was stated:

> "According to the investigating officer's report, the large truck crashes are hardly ever related to the truck driver's use of alcohol prior to the crash or to other physical conditions such as sleep or fatigue."
>
> (Lohman and Waller, 1975)

The reported incidence of drinking is presented below.

TABLE 6

Large Truck Driver Condition by Crash Type

(Lohman and Waller, 1975)

	Crash Type		
Large Truck Driver Condition	Single Vehicle Accident %	Other %	Total %
Sober	90.5	91.1	91.0
Drinking: Ability Impaired	1.5	0.4	0.6
Drinking: Unable to Determine Impairment	2.3	0.2	0.6
Not Stated	5.7	8.3	7.8
TOTAL (N)	100.0 (1,097)	100.0 (4,556)	100.0 (5,653)

Although only 1.2 percent of the heavy truck drivers were reported as drinking*, the incidence in single vehicle accidents was significantly** higher (3.8%). It was also reported whether a chemical test was administered

*In Table 6 the combined total for the two drinking conditions is 1.2% (0.6 + 0.6).

**$X^2 = 87.73$ df = 3 $p < .001$

to the driver. These data were compared with the reported drinking involvement in order to provide an estimate of the extent of the enforcement. It was found that for all vehicle types, except heavy trucks, the proportion of drivers to whom chemical tests were administered was approximately the same or lower than the reported incidence of drinking. For heavy truck drivers, however, chemical tests were administered to proportionately more drivers than were reported to have been drinking. The authors interpreted this to mean that drunk driving laws may be more strictly enforced for drivers of heavy trucks than for drivers of other vehicles (Lohman and Waller, 1975).

These authors also examined the incidence of fatigue and dozing in their sample of heavy truck accidents. Unlike the previously noted studies, these proportions (0.4% and 0.5%, respectively) were smaller than the corresponding proportion of drinking involvement presented in Table 12. Like drinking, however, both fatigue and sleeping were found more often in single vehicle accidents than in other accidents (Lohman and Waller, 1975).

Scott and O'Day (1971) conducted an analysis of truck involvements using police reported data, BMCS data, and turnpike data. Whereas fatigue or falling asleep was identified in this analysis as a "serious problem" among truck drivers, drinking is only mentioned in passing. According to these authors, "Indication of the use of alcohol by drivers of large trucks was conspicuous by its absence." (p. 106)

From this set of reports, it appears that the police-reported incidence of drinking among heavy truck drivers involved in accidents is approximately 2.0% for fatal accidents, and slightly less for non-fatal accidents. With one exception (Lohman and Waller, 1975), dozing was reported approximately 2-3 times as often as drinking, suggesting that falling asleep at the wheel may be a more serious problem for heavy truck drivers than drinking. Similar conclusions have been presented by several researchers (Scott and O'Day, 1971; Li, et al., 1979).

Reports using blood tests. The second category of studies includes those for which alcohol use was determined from the results of blood tests taken primarily from fatally injured drivers. The most often cited study in this category was conducted by Baker (1975), who used a sample of 150 fatal crashes involving tractor-trailers which occurred in Maryland during 1970-1973. From this sample, 25 tractor-trailer drivers and 63 drivers of other motor vehicles who died as a result of their accident involvement were tested for alcohol. It was found that 36% of the tractor-trailer drivers and 53% of the automobile drivers had measurable amounts of alcohol in their blood. However, when BAC = 0.10% was used as a cutoff, the proportions were 32% for tractor-trailers and 34% for automobile drivers.

For tractor-trailer drivers only, Baker compared the proportion of drivers with BAC's of 0.10% or more with judged responsibility for the accident. Whereas 8 of 17 "responsible" tractor-trailer drivers were found to have BAC's of 0.10% or more, the corresponding proportion of "other"* drivers was 0.0%. From this, she concluded that alcohol plays an important role in heavy truck accidents (Baker, 1975).

Using coroners' reports from Alameda and Sacramento counties, California in conjunction with police reports of drinking involvement and accident responsibility for crashes from mid-1963 or early 1964 to 1967, Waller (1970) studied all collisions in which a driver or pedestrian was fatally injured, and in which a pick-up, small panel truck, or larger truck or bus was involved. It was found that of four fatally injured drivers of large trucks or buses, two of whom were determined to have been responsible for their respective collisions, no alcohol was present. For the 38 drivers of large trucks who survived their collisions, the truck driver was determined to have been responsible in 7 accidents (18.4%). None

* Other included (1) driver not responsible (N=4), and (2) responsibility not determined (N=4).

of these drivers was reported to have been drinking. Surviving, non-responsible drivers in 29 collisions were all not reported to have been drinking. For this set of collisions alcohol was found in 17 (60.9%) of the fatally injured drivers or pedestrians who were involved in a collision with the heavy truck.

In addition to his analysis, Waller also provided information which confirms the general absence of extensive data pertaining to the use of alcohol by truck drivers. He claims to have conducted an "extensive review of literature on alcohol and highway safety" (p. 254). He found only one reference to a study conducted by the New Jersey Division of Motor Vehicles. The findings of this study are summarized by Waller:

> "Alcohol was present in 19 fatally injured drivers of trucks of unknown size and five tractor-trailers in New Jersey. The number of truck crashes in which persons were fatally injured and in which alcohol was not found was not reported." (Waller, 1970, p. 254)

A study of fatally injured drivers in Canada occurring in 1976 was conducted by Simpson, et al. (1978) at the Traffic Injury Research Foundation of Canada. The data used for this analysis consisted of essentially* all motor vehicle accident-related fatalities occurring in a seven province area (plus greater Montreal). As presented by Simpson, the percentages of drinking involvement are somewhat conservative in that they are based upon the assumption that the drivers not tested had zero blood alcohol. For this reason, the percentages were recalculated with the "unknowns" omitted. These data are presented in Table 13.

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* According to the authors, definitional differences which exist among the provinces may account for differential inclusion or exclusion of a few motor vehicle fatalities.

TABLE 7

Adjusted Incidence of Alcohol Use by Vehicle Type, 1976 Accidents

(Simpson, et al., 1978)

Vehicle Type	# Fatally Injured	# Tested	% Tested	Adjusted Percentage (Omitting not tested drivers) HBD	Impaired
Autos	1119	886	79	59	48
Trucks/Vans	291	230	79	62	53
Motorcycles	153	106	69	58	42
Tractor-Trailers	32	25	78	32	32
Snowmobiles	52	37	71	85	73

In this and the following table, the HBD (Had Been Drinking) category consists of drivers tested and found to have blood alcohol levels greater than 0.01%. Impaired drivers were those found to have a blood-alcohol level of at least 0.08% (the current Canadian legal limit). Based upon the results of 25 blood tests, the incidence of drinking among fatally injured heavy truck drivers was 32%, a rate which is smaller than found for drivers of other vehicle types. However, unlike the findings for drivers of other vehicle types, Simpson found that all heavy truck drivers having positive BAC's were legally impaired (Simpson, et al., 1978).

Considering only fatally injured tractor-trailer drivers tested for alcohol involvement, the following table presents the adjusted percentages of HBD and Impairment, as recalculated from the data of Simpson, et al. (1978). For the three-year period, 1974-1976, it can be seen that the alcohol involvement rate increased substantially. The overall rate of drinking involvement was 24%.

TABLE 8

Alcohol Use Among Fatally Injured Heavy Truck Drivers
Tested for BAC by Year of Accident
(Simpson, et al., 1978)*

Year	# Drivers Tested	% Tested BAC	Adjusted Percent HBD	Adjusted Percent Impaired
1974	27	73	19	11
1975	23	68	22	9
1976	25	78	32	32
Total	75	73	24	17

While studies such as the three described do provide accurate information concerning the amount of alcohol in the driver's blood shortly after the accident, the generality of the results is limited for several reasons. First, the small samples generally used in these studies limit the power of any statistical tests performed on the data. Second, the use of the restrictive subset of tractor-trailer accidents in which the tractor-trailer driver was killed limits any generalization to the population of accidents with this consequence. Since, according to statistics presented earlier, the proportion of tractor-trailer accidents resulting in a fatality to the tractor-trailer driver is extremely small, there is some basis for questioning whether these crashes adequately represent all heavy truck accidents, or even all heavy truck accidents involving any fatality. The nature of the accident samples also restricts the types of comparisons permitted. For example, in Baker's (1975) study, comparisons between tractor-trailer drivers and automobile drivers are potentially biased due to the exclusion of single vehicle automobile accidents (an established drinking accident type).

* Data presented in this table have been recalculated from those presented by Simpson, et al. (1978).

Within these constraints, however, the results of these studies do provide useful information concerning alcohol use among heavy truck drivers. For example, in Simpson's (1978) study, the tractor-trailer drivers were the only group of drivers for which all drivers detected to have been using alcohol were legally impaired (BAC $\leq$ .08%). This finding is consistent with the finding of Baker that given the presence of alcohol, tractor-trailer drivers were more likely than drivers of automobiles to have BAC's greater than .10% (1975). Together these findings suggest that any use of alcohol among fatally-injured heavy truck drivers implies excessive (or at least to the point of legal intoxication) use.

The results of Simpson's (1978) study also provide useful information concerning the problem of alcohol use by heavy truck drivers relative to that of other fatally injured drivers. From Table 7, it is evident that for both categories of alcohol use, the incidence among fatally injured heavy truck drivers was less than among fatally injured drivers of other vehicles. Although only four tractor-trailer drivers were tested in the study by Waller (1970), a comparison between these drivers and fatally injured light truck drivers was made. According to Waller, of 15 fatally injured light truck drivers, all were responsible for their crashes and 13 had alcohol present. Eight had BAC's of .10% or greater (Waller, 1970).

Police underreporting of alcohol use in accidents. Although Lohman and Waller (1975) suggested that drunk driving laws may be more strictly enforced for heavy truck drivers than for drivers of other vehicles, discrepancies between the two sets of reviewed studies suggest that alcohol use among heavy truck drivers is underreported by police officers investigating the accident. The consistent police-reported 2% alcohol involvement rate differs considerably from the rates found by Baker (35%) and Simpson (24%). Evidence in support of the conclusion of police underreporting is presented by both Waller (1970) and Baker (1975), who made comparisons between the police-reported alcohol involvement and BAC's obtained from their samples of fatally injured heavy truck drivers.

Waller reported that of 21 fatally injured persons with measured BAC's of 0.10% or greater, drinking was reported by the police in 48% (10). For 38% (8) of these drivers the police reported no drinking and in 10% (2), no mention of alcohol was made. In only one case did the officer record that he did not have enough information to accurately judge the use of alcohol. Waller continued by showing that the accuracy of police assessments of alcohol interacts with crash responsibility, in that the accuracy was higher for non-responsible drivers than for responsible drivers (Waller, 1970).

In Baker's study, it was reported that 3 of 8 tractor-trailer drivers with BAC's of 0.10% or more were reported as "apparently normal," as were 8 of 21 drivers of other vehicles with similarly high BAC's. Baker also reported a case in which a driver with a BAC of 0.25% was described as "apparently asleep" (Baker, 1975).

There are several factors which deserve mention with regard to the issue of police-underreporting. First, as evidence for the difficulty of making the required determination, Waller (1970) cited an experimental study in which it was found that physicians were no more accurate than police officers in identifying alcohol effects based only on clinical data. This difficulty of determination is compounded when accidents fatal to the truck driver are at issue because police officers have almost no information upon which to make their assessment. Without being able to observe and/or converse with the driver, the likelihood of an accurate determination is reduced from difficult to nearly impossible. In other words, the determination of alcohol use among fatally injured drivers presents the worst possible case for the police officers.

A second problem which arises when comparing police reported incidence of alcohol with chemical test results is the method of selecting drivers to be chemically tested. Whereas a determination of alcohol involvement is made by the police for all accident-involved drivers, the selection of drivers for chemical testing in many states requires that police officers have "probable cause" for suspecting alcohol involvement. In other words, only drivers exhibiting obvious symptoms of impairment are ordinarily selected for testing. This problem, however, does not exist when all fatally injured drivers are tested for alcohol involvement, as was the case with the studies of Baker (1975), Waller (1970), and Simpson (1978).

Summary of results from published accident studies. A summary of the results of the reviewed published accident studies is presented in Table 15, showing the reported percentage of alcohol involvement among the various samples of accident-involved heavy truck drivers. Most apparent is the fact that the incidence varies according to the source of the reporting of alcohol involvement. Police-reported incidence is approximately 1-2%, regardless of the type of accidents included. The previously mentioned under-reporting of alcohol involvement by BMCS is also apparent. The highest incidences of alcohol involvement were reported for accidents in which the truck driver was killed, and for which the results of blood tests were used to determine alcohol involvement.

From the published accident studies it was also consistently found that the incidence of alcohol use among accident-involved heavy truck drivers is generally less than the corresponding incidences associated with drivers of other vehicle types. As compared to other driver conditions, falling asleep at the wheel appears to be a more significant problem than drinking for heavy truck drivers. However, because of the documented difficulty in determining alcohol involvement, some cases in which the driver was reported as falling asleep may have involved alcohol.

TABLE 9

Summary of Published Results of Alcohol Incidence
Among Accident-Involved Heavy Truck Drivers

Study	Accidents Included	% Reported Alcohol Involvement*	Source of Alcohol Reporting	N	Accident Year
BMCS (1975)	All BMCS reported	0.6	BMCS	30,911	1973
BMCS (1977)	All BMCS reported	0.5	BMCS	29,936	1977
Cassidy (1978)	FARS	2.0	Police	5,781	1975, 1976
Ernst & Ernst (1968)	All truck accidents	1.9	Police	9,102	1965
Fleischer (1979)	All commercial vehicle accidents	1.0	Police	3,022	May 1975-May 1976
Lohman & Waller (1975)	All accidents	1.2	Police	5,653	1973
Baker (1975)	Accidents fatal to truck drivers	36.0	BAC	25	1970-1973
Simpson, et al. (1978)	Accidents fatal to truck drivers	24.0	BAC	75	1974-1976

*Interpretation of Alcohol Involvement differs slightly among the various studies. Police-reported and BMCS-reported alcohol involvement generally reflect a judgment that alcohol had a causal effect in the accident. Studies using BAC's indicate presence of alcohol in blood.

Non-accident studies. The search for published reports pertaining to alcohol use by heavy truck drivers identified two reports which addressed the topic through the use of survey, rather than accident data. The first is a recently published book by Wyckoff (1979) entitled "Truck Drivers in America." The major portion of this book consists of discussion and analysis of the results of a survey of heavy truck drivers conducted by Wyckoff. Of 65,000 questionnaires distributed primarily through truck stops and truck lines, approximately 12,000 were returned. Of these, 9,630 were used in the data tabulations.*

The use of alcohol by drivers responding to Wyckoff's survey was determined by asking each driver how long after drinking he would wait before being willing to drive his truck. The answers to this question, tabulated by driver age, are presented in Table 16. It is apparent that reported willingness to drive within four hours of alcohol consumption is greatest for the youngest drivers and decreases with age. While drivers in the 25-50 age group had the highest percentage of drivers who chose to wait four hours or more before driving, drivers over age 50 were most likely to abstain from alcohol consumption (Wyckoff, 1979).

Wyckoff compared the proportion of reported non-drinkers with a Census Bureau publication which gives an overall proportion of alcohol use among adults in the United States. Based upon this comparison he concluded that his respondents exhibited a slightly higher rate of abstention from alcoholic beverages than found in the overall population (Wyckoff, 1979).

*As a result of discussions with several individuals knowledgeable about the trucking industry, we feel it necessary to warn the reader that Wyckoff's results and conclusions have been criticized on methodological grounds.

TABLE 10

Attitude Toward Alcoholic Beverages, Reported by Regulatory Status and Age of Driver

(Wyckoff, 1979)

Attitude Toward Alcoholic Beverages	Driver's Age <25 %		25-50 %		>50 %	
Do not drink	47.3		45.1		56.8	
Can drive satisfactorily without waiting	7.5	16.4	2.5	6.7	1.6	3.6
Wait about 1 hour to drive	2.4		1.1		0.7	
Wait about 2 hours to drive	4.1		1.9		0.7	
Wait about 3 hours to drive	2.4		1.2		0.6	
Wait about 4 hours to drive	36.4		48.3		39.7	
TOTAL	100.0		100.0		100.0	

The second identified non-accident study was a survey of "long distance truck drivers" conducted in New South Wales, Australia (Linklater, 1977, 1978). Data for the study were collected on the major roads of New South Wales during May, 1976. Using self-reports of accident involvement, it was found that the sample of 615 long distance truck drivers were involved in more crashes than drivers of other vehicles. Differences in life style, attitudes, and opinions were hypothesized to have contributed to the differences in frequency of accident involvement. The analysis revealed that exposure (measured in weekly hours behind the wheel) was most important in predicting crash frequency.

As part of the analysis, the relationship between self-reported usage of alcohol and crash frequency was found not to be significant. Alcohol usage was found to be significantly related to financial worry, experience of

hallucinations, and aggression (anger, fist-fighting). To evaluate the possibility that exposure may have suppressed the effect of alcohol on crash frequency, exposure was controlled and the effect of alcohol usage on crash frequency was reevaluated. No effect was found. The author suggested that the small numbers of heavy drinkers may have hidden any statistically significant effects (Linklater, 1978).

Of interest for the current investigation is the reported incidence of drinking among the sampled truck drivers. The following table presents the daily self-reported consumption of alcohol for the sampled truck drivers categorized by exposure.

TABLE 11

Reported Daily Alcohol Consumption by Weekly Exposure

(Linklater, 1978)

Alcohol Consumption Per Day	Low Exposure ≤ 45 hrs.		Medium Exposure 46-65 hrs.		High Exposure > 65 hrs.		Total	
	N	%	N	%	N	%	N	%
None	24	14.5	31	12.4	27	16.0	82	14.1
1-7 drinks	133	80.6	204	81.9	129	76.3	466	79.9
Over 7 drinks	8	4.8	14	5.6	13	7.7	35	6.0
Total	165	100.0	249	100.0	169	100.0	583	100.0

These data reveal that the proportion of heavy truck drivers who drink more than seven drinks daily increases with exposure. It is also evident that those drivers with high exposure are most likely not to drink at all. These differences, however, are not statistically significant ($x^2 = 2.57$, $df = 4$, $p > 0.5$).

Although neither of the reviewed studies presents explicit information pertaining to the incidence of drinking and driving by heavy truck drivers, Wyckoff's results allow an estimation of the magnitude of the problem. Using frequencies of drivers within each category of regulated status in combination with percentages associated with the various responses to the question of willingness to drive following alcohol consumption, an overall percentage of willingness to drive following drinking was calculated. It was found that approximately 5.7 percent of Wyckoff's sample reported being willing to drive within four hours of alcohol consumption.

The results of the two surveys allow comparison of the overall drinking habits of the sampled truck drivers. Whereas according to Wyckoff (1979), approximately 50 percent of his sampled drivers report total abstention from drinking, the corresponding percentage reported by Linklater (1978) was 14.1. This discrepancy can be interpreted to reflect cultural differences between the United States and Australia.

2.3 Other Data Sources

To supplement the published information pertaining to alcohol use by heavy truck drivers, telephone inquiries were made of selected individuals. The objective was to identify data files which might contain relevant unpublished information. The following research organizations were identified as having potentially relevant data.

- Dr. Wyckoff - Harvard University
- Human Factors Research
- Traffic Injury Research Foundation (TIRF), Ottawa, Canada
- Highway Safety Research Institute, University of Michigan

The data of Dr. Wyckoff and the TIRF have been discussed previously in connection with published reports (Wyckoff, 1979; Simpson, et al., 1978). Both of these sources have indicated that additional analyses could readily be performed on the respective data sets. The remaining two data sources are discussed in Appendix C.

In addition to these data files, discussions with federal agencies led to the conclusion that the most useful data source was NHTSA's FARS file. The following section presents the results of analyses conducted on the FARS file.

2.4 Analysis of FARS Data

Fatal accidents deserve special attention not only because of the unacceptable losses involved, but because there is reason to believe that reporting biases may well be limited. First, essentially all fatal accidents are investigated by the police. Second, the attention-getting value of fatal accidents results in more detailed, accurate accident reports. Finally, there is a federal standard calling for alcohol testing of all drivers in fatal accidents.

In order to examine the utility of FARS data for describing the truck alcohol problem, analyses were run through NHTSA's National Center for Statistics and Analysis to obtain the frequency of alcohol testing in fatal accidents in each of the states. The intent was to determine if any of the states were particularly thorough in testing for alcohol and thus might provide minimally biased data for assessing the truck alcohol problem. Initial analyses were limited to fatally injured drivers. Heavy trucks and all other vehicles were examined separately. Heavy trucks were defined according to the FARS criterion of single unit vehicles with a gross vehicle weight of 26,000 pounds for more and all multi-unit trucks. Data from accidents occurring in 1977 and 1978 were used.

TABLE 12

Alcohol Testing of Fatally Injured Drivers

(FARS Data)

Test Disposition	Heavy Trucks N	Heavy Trucks %	Other Vehicles N	Other Vehicles %
	- - All States - -			
Tested - BAC Known	628	37.8	22,527	42.7
Tested - BAC Unknown	189	11.4	6,445	12.2
Not Tested	680	40.9	17,654	33.4
Unknown if Tested	164	9.9	6,168	11.7
TOTAL	1,661	100.0	52,794	100.0
Test Rate		49.2		54.9
	- - High Test Rate States - - (9 States)			
Tested - BAC Known	222	84.1	9,134	84.8
Tested - BAC Unknown	9	3.4	202	1.9
Not Tested	31	11.7	1,387	12.9
Unknown if Tested	2	0.8	50	0.5
TOTAL	264	100.0	10,773	100.0
Test Rate		87.5		86.7

The response variable had four levels: (1) no test given, (2) test given - BAC known, (3) test given - BAC unknown; and (4) unknown if test given. Alcohol test rates were computed as the percent of fatally injured drivers who were tested even if specific BAC values were not available in the FARS file; i.e., items (2) and (3) above were used.

Special attention was given to states in which over 80 percent of the heavy truck and the other vehicle drivers were tested; these states would be least susceptible to biases due to driver selection. Nine states achieved this level: California, Colorado, Delaware, Nevada, New Hampshire, New Jersey, Oregon, Washington, and Wisconsin. Testing rate data are given in Table 18 for the whole country and for the composite of these high test rate states.

First, considering all states, the test rate for fatally injured heavy truck drivers was 49 percent; for drivers of other vehicles, it was 55 percent. Both of these rates were low enough to allow for the possibility of considerable driver selection bias. The lower part of the table reflects only the high test rate states where the opportunity for biases was much more limited. In these states virtually seven out of eight fatally injured drivers were tested for alcohol. Notice that the rates for both trucks and other vehicles were almost identical; they differed by less than one percent.

BAC's among fatally injured drivers. BAC distributions were derived from the composite of the high test rate states. Results are shown in Table 19. These data show that 19 percent of the fatally injured truck drivers had been drinking; among fatally injured drivers of all other vehicles, 58 percent had been drinking. Thus, the drinking rate was higher in the other vehicles by a factor of three. Among the drinkers, 70 percent (30/43) of the truck drivers had BAC's of at least .10%; for other vehicles, the figure was a not too dissimilar 80 percent (4232/5284). Thus, while BAC's among the drinkers were not greatly different, the incidence of drinking, per se, was far lower for drivers of heavy trucks than for drivers of other vehicles.

TABLE 13

Blood Alcohol Levels for Fatally Injured Drivers

(FARS Data)

BAC	Heavy Trucks N	Heavy Trucks %	Other Vehicles N	Other Vehicles %
	- - High Test Rate States - -			
.00 %	179	80.6	3,850	42.2
.01-.09 %	13	5.9	1,052	11.5
.10+ %	30	13.5	4,232	46.3
Total	222	100.0	9,134	100.0
.01+ %		19.4		57.8
	-- Low Test Rate States - -			
.00 %	52	69.3	896	29.1
.01-.09 %	11	14.7	410	13.3
.10+ %	12	16.0	1,776	57.6
Total	75	100.0	3,082	100.0
.01+ %		30.7		70.9

Data are also shown for 18 states in which the test rate was less than 50 percent; that is, for those states in which there was a greater opportunity for driver-selection induced biases. The drinking rates for these states were noticeably greater than for the high test rate states. Although the resultant distortions shown in Table 19 are not extreme, it was decided to minimize biases in further analyses by using data only from the high test rate states.

BAC's among surviving drivers. While the BAC's for heavy trucks in high test rate states as given in Table 13 provide a useful measure of the magnitude of the truck-alcohol problem, these findings apply only to fatally injured drivers. In an attempt to expand the universe of application, the FARS data were analyzed with regard to nonfatally injured drivers in fatal accidents. The approach was the same as applied to fatally injured drivers. Initially, the same nine states were used, but since the resultant test rate

for truck drivers was only ten percent, new states were selected. Because the test rate was so low, the criterion for state selection was lowered to 50 percent. (Actually, due to the dearth of qualifying states, one state at 49 percent was included.) Only three states met this criterion; they were Colorado, Delaware, and Nebraska. The resultant test rates are shown in Table 14 and the BAC's in Table 15.

The upper portion of Table 14 shows that when considering the whole country, test rates for drivers who were not fatally injured were extremely low even though these drivers were involved in fatal accidents; the test rates were seven and 17 percent for trucks and other vehicles, respectively. In the three high test states, the rates were considerably higher, but clearly not high enough to preclude the possibility of serious bias in the BAC's.

The BAC's in the high test states differed considerably from those previously found for fatally injured drivers, particularly for truck drivers. Whereas 19 percent of the fatally injured truck drivers had been drinking, only three percent of the surviving truck drivers were drinking. This difference could be due to (1) the use of different states, (2) the limited sample size, (3) biases associated with the low test rate, and/or (4) real differences between fatally injured drivers and survivors. As a minimum, uncertainty due to the low test rate precludes the use of these data for the estimation of the magnitude of the truck alcohol problem.

TABLE 14

Alcohol Testing of Surviving Drivers in Fatal Accidents

(FARS Data)

Test Disposition	Heavy Trucks N	Heavy Trucks %	Other Vehicles N	Other Vehicles %
	- - All States - -			
Tested - BAC Known	339	5.1	7,157	11.5
Tested - BAC Unknown	120	1.8	3,339	5.4
Not Tested	5,356	80.1	42,419	68.0
Unknown if Tested	870	13.0	9,468	15.2
TOTAL	6,685	100.0	62,383	100.0
Test Rate		6.9		16.8
	- - High Test Rate States - - (3 States)			
Tested - BAC Known	80	51.6	769	56.8
Tested - BAC Unknown	2	1.3	11	0.8
Not Tested	67	43.2	553	40.8
Unknown if Tested	6	3.9	22	1.6
TOTAL	155	100.0	1,355	100.0
Test Rate		52.9		57.6

TABLE 15

Blood Alcohol Levels for Surviving Drivers in Fatal Accidents
(FARS Data)

BAC	Heavy Trucks N	Heavy Trucks %	Other Vehicles N	Other Vehicles %
	- - High Test Rate States - -			
.00 %	78	97.5	427	55.5
.01-.09 %	0	0.0	114	14.8
.10+ %	2	2.5	228	29.6
Total	80	100.0	769	100.0
.01+ %		2.5		44.5

In summary, while the FARS data provided useful estimates of drinking rates for fatally injured drivers, due to low test rates, estimates for surviving drivers were judged as far too susceptible to selection biases.

In order to obtain some estimate of the drinking rate that is not limited to fatally injured drivers, reliance was placed on previously reported data; namely, those given in Jones and Joscelyn (1978). First note that the FARS data for fatally injured drivers of "other" vehicles* showed relative frequencies for BAC's (0%, .01-.09%, and .10% plus) to be .42, .12, and .46, respectively. Similar data presented in Jones and Joscelyn give .40, .13, and .47. The similarity is striking and tends to support the reliability of the findings and the efficiency of the methods used.

* The FARS "other" vehicle data exclude heavy trucks, but since only a small portion of fatal accidents involve heavy trucks, the effect is small.

It was shown earlier using the FARS data that the drinking rate for fatally injured heavy truck drivers was one-third that for fatally injured drivers of other vehicles. On the premise that this ratio applies to accidents of lesser severity, data presented in the Jones and Joscelyn report can be used to estimate the drinking rate for truck drivers in the lower severity accidents. This is shown in Table 16.

TABLE 16

Estimated Drinking Rates for Drivers of Heavy Trucks by Accident Severity

Accident Severity	Data Source	Reported* Drinking Rate	Rate for Heavy Trucks
Fatal (Fatally Injured Drivers)	FARS	58%	19%
Personal Injury	Farris, et al., (1976) and Borkenstein, et al., (1964)	25%	8% (est.)
Property Damage	Borkenstein, et al., (1964)	16%	5% (est.)

*Data sources differ slightly in terms of vehicle types included as follows: FARS - all vehicles excluding heavy trucks; Farris, et al. - automobiles only; Borkenstein, et al. - all vehicle types. These differences should not significantly affect comparability of the rates.

As reported earlier, the Ernst and Ernst (1968) study showed a two percent drinking rate on the basis of police reports. Since most of their data were based on property damage accidents, this value can be reasonably compared to the five percent shown in Table 22. The Ernst and Ernst data can be questioned due to their reliance on police reports which are likely to under-represent the problem. The value from Table 22 can be questioned due to the assumption of a constant truck-other vehicle drinking ratio. Since the Ernst and Ernst value is likely to be an underestimate, the five percent value seems to be a reasonable figure with currently available information.

To summarize, our best estimates of drinking rates among heavy truck drivers in accidents are 19 percent for fatally injured drivers and five percent for drivers in property damage accidents; the former is quite well documented, but the latter is not. Among fatally injured drivers, the drinking rate for heavy trucks was one-third that for other vehicles.

2.5 Solicited Opinions About Magnitude of Problem

In addition to the identification of potential data sources, subjective assessments of the magnitude of the heavy truck-alcohol problem were solicited from selected individuals. The obtained information is summarized in this section and presented in detail in Appendix D.

By way of background, it should be noted that a predictable but unanticipated factor came into play in considering the comments in these discussions. Specifically, while some comments in early discussions seemed reasonable, as the project staff was exposed to more information, conflicting statements were found, and in many instances the conflicts remained unresolved. In general, we simply had no means to test the validity of much of the information obtained. Thus, the items that follow are best viewed as based on opinion. Their purpose is to indicate the views of individuals involved in the trucking industry, safety management, or research, and perhaps to provide insights requiring further investigation. One final warning: because of the informal way in which these views were obtained, there was no statistically meaningful sampling plan; hence, none of the views should be taken to reflect a consensus or even a majority opinion.

Regarding the magnitude of the truck alcohol problem:

- Drinking can be a serious problem for individual truck drivers, but the overall problem is not extensive.

- Most sources of information about drinking are not reliable.

- Due to the lack of good data, the magnitude of the problem is underestimated.

A major problem with the subjective assessments of the magnitude of the alcohol problem was the inability to separate drinking that might influence on-the-job activities from what might be less hazardous forms of alcohol use.

Thus, because of a lack of documentation, a variety of experience, and perhaps individual differences regarding what constitutes an alcohol problem, there was no generally agreed-upon view of the extent of the alcohol problem among heavy truck drivers.

3. NATURE OF ALCOHOL USE BY HEAVY TRUCK DRIVERS

Having established that some proportion of heavy truck drivers combine driving and drinking, it now remains to determine the nature of the problem, including the circumstances under which such drinking occurs. The ultimate objective is to ascertain the degree of similarity or dissimilarity to the general driver alcohol problem. As in the previous section, both accident and non-accident studies were considered. Additional analyses of existing accident data were performed to identify the causal attributes of alcohol-related collisions involving heavy trucks.

Non-accident studies were used to identify the circumstances under which heavy truck drivers are most likely to drink. Because the regulated status of heavy truck drivers has been considered as a possible avenue for countermeasure application, the use of alcohol is examined within the context of the BMCS regulations. Finally, because the skill requirements and attentional demands of heavy truck driving differ from those of automobile driving, information is presented to support the hypothesis that in certain driving situations, heavy truck drivers may be more susceptible to the effects of alcohol than drivers of automobiles.

The search for relevant data sources identified no published reports which documented the circumstances of alcohol use by accident-involved heavy truck drivers. Several of the previously reviewed studies, however, made brief mention or speculation about this topic. Baker (1975), for example, found that tractor-trailer drivers with positive BAC's were older than those with negative BAC's (median age 41 and 31.5, respectively). Using the state of driver registration, she speculated that alcohol usage may be less common for long distance accident-involved truck drivers than for local drivers (Baker, 1975).

Lohman and Waller (1975) found drinking to be associated proportionately more often with single vehicle accidents than with other accidents. No other identified accident studies discussed the circumstances or accident types of drinking heavy truck drivers. Because so little relevant information was available, additional analyses were conducted using the NHTSA's FARS data file.

3.1 Analysis of FARS Data

The following is a review of findings determined from simple cross tabulations of accident factors with BAC.* The tabulations and selected statistics can be found in Appendix C. Because of the limited number of drinking truck drivers in this data set (there were only 73), only two BAC categories were used: drinkers (measured BAC greater than 0) and non-drinkers (measured BAC equals 0). Similarly, because of the small number of observations only simple two-way tables were analyzed (with one exception). Accident factors involved driver-related variables, accident characteristics, accident circumstances, and roadway characteristics.

For each table, several statistics were uniformly computed.** The first were relative frequencies of the levels of the accident factors for

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*These analyses were based on data for the years 1975 to 1978. An analysis comparing the first two years to the last two showed very similar test rates.

**In order to limit the use of statistics based on a very low number of observations, categories such as "other" or "unknown" and some others were excluded from the computed proportions and test statistics. For specifics, see Appendix B.

drinking truck drivers. These results best state the nature of the drinkers' problems. Next, these relative frequencies were compared to those for nondrinking truck drivers. This provides a view of whether problems are specific to drinkers or common to all the truck drivers. Third, the drinking truck drivers were compared to drinking drivers of other vehicles. In this way, information is provided suggesting whether the problems of drinking truck drivers are common to the general drinking driver population or are unique to truck drivers.

Chi-square tests were conducted for the truck-drinker versus truck-non-drinker and truck-drinker versus other vehicle-drinker comparisons; where differences were significant at the .05 level, they are denoted by "(S)". The reader is cautioned that in such a multiple testing situation, the likelihood of spuriously significant findings is elevated. On the other hand, because there were only 73 drinking truck drivers in the sample, the power of the tests was limited.

Nonetheless, because these data represent almost all accidents in the high test rate states, differences must be treated as "real" for those states. Generalizations to other states can be justified only for findings reaching significance and only if there is reason to believe the other states are adequately represented by the high test states. The reader is reminded that the data represent only drivers killed in accidents.

Driver-related variables. Eighty-one percent of the drinking truck drivers were 26 to 55 years old and 44 percent were between 26 and 35 years old. Seventy-eight percent of them were driving without passengers in the vehicle, and nine percent had previous drinking convictions (not simply arrests or citations, but convictions).

In comparisons to the non-drinking truck drivers, the drinking drivers were overrepresented only in the 26 to 35 age group; they were equally as likely to have passengers in the vehicle; and they were almost twice as likely to have previous drinking convictions. Thus, although the drinking drivers were somewhat younger, they nonetheless were more likely to have been previously convicted of driving under the influence of alcohol.

In comparison to drinking drivers of other vehicles, the drinking drivers were underrepresented in the 25-and-under age group (almost one-half of the other vehicle drinkers were in that group) (S). The truck drivers were more often alone in their vehicles (although two-thirds of the other drivers were alone) (S), and they had about one-half the previous drinking conviction rate.

Thus, there were relatively more drinking truck drivers in the 26 to 35 age range than were found in either of the other groups. Fewer of the truck drivers had passengers, irrespective of drinking status, than did drivers of other vehicles. Finally, more drinking truck drivers had DWI* convictions than did non-drinking truck drivers, but fewer did so in comparison to drinking drivers of other vehicles.

Accident characteristics. Fully 79 percent of the drinking drivers' accidents were single-vehicle accidents. Eighty-six percent of their accidents did not occur at road junctions and yet of their multivehicle accidents, half involved angle collisions suggesting intersections. (Note that there were only fourteen multivehicle accidents for the drinking truck drivers.)

* Driving While Intoxicated

When compared to non-drinking truck drivers, the drinker had more single vehicle accidents (S), an equal proportion of accidents at road junctions, and among multivehicle accidents, more angle impacts and far fewer rear end accidents. The most familiar of these findings is the greater proportion of single-vehicle accidents among drinking drivers.

In comparison to drinking drivers of other vehicles, the drinking truck drivers had a higher proportion of single vehicle accidents (the other drivers had 65 percent) (S), an approximately equal proportion of accidents at road junctions, and among multivehicle accidents, more angle and rear end impacts but fewer head-on collisions.

Thus, while drinkers in the general population suffered serious problems in terms of the incidence of single-vehicle accidents, the problem was even more extreme among drinking truck drivers. The three groups had almost equal proportions of intersection accidents. Lacking more data, no interpretation is offered here regarding differences in multivehicle collision characteristics.

Accident circumstances. The drinking truck drivers had 84 percent of their accidents on weekdays (Monday through Saturday). Fifty-seven percent occurred at night, with only 22 percent between 6 am - 3 pm, while 24 percent occurred between midnight and 3 am. Eighty-four percent of their accidents were on dry roads, eleven percent on wet, and five percent on ice or snow covered roads.

When compared to non-drinking truck drivers, the drinkers showed little difference regarding weekdays versus weekends, thereby indicating that their low proportion of weekend accidents was characteristic of all truck drivers, not just drinking truck drivers. The drinking truck drivers had proportionately more of their accidents at night (S), the same phenomenon typically seen in the general population. In particular, the drinkers had proportionately more of their accidents between 3 pm and 3 am., and particularly so between midnight and 2 am. There was no notable difference between the two groups in terms of road surface conditions.

In comparison to drinking drivers of other vehicles, the drinking truck drivers had a much higher proportion of their accidents on weekdays (S), reflecting truck drivers' typical working schedules and the fact that other drivers do much of their drinking on weekends. That the drinking truck drivers had almost half of their accidents during the daytime was in sharp contrast with other drinking drivers who had one-fourth of their accidents in daylight (S). In terms of three-hour segments, the truck drivers had more of their accidents between 3 pm and 6 pm (S). While truck drivers, both drinkers and non-drinkers, had approximately five percent of their accidents on icy or snowy roads, the figure was two percent for drivers of other vehicles.

Thus, differential problems were noted for drinking truck drivers versus drinkers driving other vehicles in terms of weekdays versus weekends and time of day. It is likely that these differences are primarily attributable to differential work schedules and the fact that drinking truck driver accidents probably reflect drinking on the job or just before going to work, while in the general population drinking accidents are more likely to occur during non-work periods.

Roadway characteristics. Seventy-eight percent of the drinking truck drivers had their accidents on rural roads. Fifty-two percent were on noninterstate major rural routes (U.S., state, and county highways), 26 percent were on rural interstates, and twelve percent were on urban interstates. Thus, the bulk of the accidents were on interstates and other rural routes.

In comparison to non-drinking truck drivers, the drinkers had an equivalent proportion of their accidents on rural roads and, indeed, a quite similar distribution of specific road types. Thus, in this regard, the drinking truck drivers' accidents were not unique to drinkers but common to truck drivers.

In contrast to drinking drivers of other vehicles, the drinking truck drivers had more of their accidents on rural roads (S). In particular, the drinking truck drivers were overrepresented on rural and to a lesser extent urban interstates, and underrepresented on major routes and local streets in urban areas (S), but not independent of simple urban/rural comparison). Since no drinker-non-drinker differences were found, these effects are more attributable to characteristics of truck drivers (probably their trip routes) than to factors specific to drinking. Nonetheless, these results suggest that drinking truck driver countermeasures be directed more at interstate travel than they would be for the general drinking driver population.

3.2 The Single Vehicle Accident CFSI Study

In a previous CFSI* study (Perchonok, et al., 1978), detailed data had been collected on single vehicle accidents on rural roads. While specially trained state police in six states collected these data, no special emphasis was placed on driver drinking status. Nonetheless, some results are summarized below because they reflect mostly non-fatal accidents and because there were some unique variables included in the data.

The accidents were intended to be all those occurring within specified geographic areas. Of those accidents in which the police reported a positive drinking or not drinking status (i.e., after eliminating unknowns), there were 462 heavy trucks for which 31 of the drivers were reported as drinking (either with or without being cited for a drinking violation) indicating a seven percent drinking rate. This is considerably lower than that from FARS which may be due to police underreporting or lower drinking rates in less severe accidents.

Despite the small sample of drinkers, there were some notable differences between the drinkers and the non-drinkers. For example, the distribution of road conditions for the non-drinkers was: dry - 62%,

* Calspan Field Services, Incorporated

wet - 14%, and ice or snow - 24%; for the drinkers, the respective percentages were 83, 13, and 3. Thus, the drinkers had a higher proportion of their accidents on dry roads and lower on wintry surfaces.

This difference, although not noted in the FARS data, may indicate an unwillingness to drive on slippery roads after drinking, reduced drinking when roads are hazardous, or that drinking drivers have proportionately more of their accidents under circumstances less troublesome to non-drinking drivers.

Another analysis pertaining to the road showed that drinking drivers of heavy trucks had fewer of their accidents on horizontal curves than did their sober breathren (25% vs. 36%).

Drinkers and non-drinkers were also compared in terms of three interrelated variables: predeparture maneuver, departure angle, and departure attitude. Departure angles were smaller for the drinkers: for them, 35 percent of the departure angles were five degrees or less; for the non-drinkers, only 21 percent were five degrees or less. Heavy trucks driven by drinkers were more likely to be tracking when departing the road; that is, the rear wheels were in line with the front wheels. For the drinkers, 82 percent were tracking, but for the non-drinkers, only 60 percent were tracking. Finally, 56 percent of the drinkers left no on-road evidence of a corrective response prior to departure; for non-drinkers, the corresponding figure was only 14 percent.

Thus, in comparison to non-drinkers, these three analyses characterize the drinkers' run-off-road accidents as involving drifting off the road at a shallow angle, without evidence of the vehicle being out of control (no sideward skidding), and no attempt to take corrective action. This suggests a driver who is asleep or grossly inattentive to the driving task.

3.3 Alcohol Use by Regulated Status

As noted at the beginning of the chapter, concern over the use of alcohol by heavy truck drivers is intensified due to the existence of BMCS safety regulations, as well as company and union policies which prohibit the use of alcohol. Specifically, BMCS-regulated truck drivers are prohibited from consuming any alcoholic beverage within four hours of going on duty or operating, possessing any alcoholic beverage while on duty, and of appearing to have consumed alcohol within four hours of duty.* Furthermore, if convicted of driving while under the influence of alcohol, operators are disqualified for one year from driving.**

Unfortunately, the existence of these regulations does not necessarily imply strict enforcement. In the course of the review of available literature studies which addressed the effectiveness and enforcement of BMCS regulations were identified and are reviewed in this section. As background for this material, a brief discussion of the structure of the motor carrier industry, drawn primarily from Wyckoff (1979) is presented.

The basic distinction in the motor-carrier industry is between for-hire carriers who carry others' goods and private carriers who carry their own goods. Private carriers are exempt from Interstate Commerce Commission (ICC) regulation. For-hire carriers are divided into interstate (regulated) and intrastate (exempt) carriers. In addition, interstate carriers which transport exempt commodities are not subject to ICC regulation. Exempt commodities are primarily unprocessed agricultural products.

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* BMCS Regulation 392.5

** BMCS Regulation 391.15

Wyckoff (1979) estimates the percentages of motor-carrier intercity ton-miles provided by the various categories of carriers. These estimates are presented in the following table:

Carrier Type	Percentage of US-intercity Ton Miles
Private	40
Interstate (Exempt Commodities)	10
Regulated Carriers	50

In addition to regulatory status, heavy truck drivers can also be categorized according to whether they are company drivers or owner-operators. Owner-operators may carry either exempt commodities or regulated commodities under subcontract to a regulated carrier. A variety of arrangements between owner operators and trucking companies are possible.

The ICC regulates the motor carrier industry through issuance of certificates of public convenience, and through the establishment of regional rates. The certificates of public convenience, which typically describe the routes or areas to be served and the commodities to be carried, are issued by the ICC only upon demonstration of a public need that the applicant is capable of satisfying. Rates are established by regional rate bureaus following hearings at which carriers and shippers present arguments.

Whereas the economic aspects of the interstate trucking industry are regulated by the ICC, safety is regulated by the Bureau of Motor Carrier Safety (BMCS). All vehicles and drivers involved in interstate or foreign commerce are subject to BMCS regulations which include the following:

- Qualifications of drivers (examination, medical certificates).
- Driving of motor vehicles (driver condition, emergency signals, use of lights, duties of drivers).

- Parts and Accessories necessary for safe operation (lighting devices, brakes, coupling devices).
- Notification, reporting of accidents.
- Hours of service of drivers.
- Inspection and maintenance.
- Transportation of Hazardous Materials.

BMCS regulations are enforced through roadside inspections conducted by the BMCS with assistance of state law officials. These inspections are intended primarily to identify defective and/or other unsafe equipment, and to remove unsafe vehicles from the highways. In addition, according to a recent summary report, the inspections are also designed to identify driver conditions which could influence the occurrence of major highway accidents (BMCS, 1978).

In 1976 and 1977, slightly more than 33,000 vehicles were inspected through BMCS roadside inspections, with approximately 34 percent of the vehicles placed out of service due to an unsafe condition. This is not to suggest, however, that 34 percent of all heavy trucks are mechanically unsafe. Vehicles selected for thorough inspection were those which upon preliminary inspection appeared most likely to have one or more unsafe conditions. In addition to the 33,000 vehicles selected for detailed inspections, many more vehicles were permitted to continue on the basis of the preliminary inspection (BMCS, 1978).

In addition to the vehicle safety violations, there were 34,585 driver violations reported during 1976 and 1977. Medical certificate requirements and miscellaneous driver requirements (seat belt use, unauthorized passengers, safe loading, etc.) each accounted for approximately 25 percent of the driver

violations. There were 854 drivers placed out of service for violations of the Hours of Service Regulations, which limit driving time per day and per week (BMCS, 1978).

Conspicuously absent from the BMCS reported driver violations was any mention of alcohol use. In light of the previous discussion concerning the magnitude of alcohol use among heavy truck drivers, it appears that alcohol use or impairment is not routinely detected in BMCS roadside inspections. Given the high rate of vehicle safety violations detected and the high rate of driver violations which can be more objectively determined, along with the known difficulty of identifying alcohol use without chemical testing equipment, it is not surprising that alcohol use is not reported in BMCS roadside safety inspections. However, because of this apparent lack of enforcement, it is possible that this particular regulation has little impact on drivers of heavy trucks. Some indirect support for this conclusion is provided by Wyckoff (1979) who suggests that of all the BMCS safety regulations, drivers are most concerned with the 10-hour driving limit.

The use of alcohol by accident-involved heavy truck drivers is presented in the BMCS accident summary report (BMCS, 1977). Of the 29,936 BMCS reported accidents which occurred in 1977, drinking was reported in 145 (0.5%). Dozing at the wheel was reported in 488 (1.6%)*. The following table presents the frequencies of these two impairments for the four categories of carrier type.

TABLE 17

BMCS-Reported Drinking and Dozing Incidence by Carrier Type

(BMCS, 1977)

Carrier Type	Drinking N	Drinking %*	Dozing N	Dozing %
Private	40	0.7	124	2.1
Authorized	97	0.4	348	1.5
Exempt	7	1.8	13	3.4
Mail and Other	1	2.3	3	6.8
TOTAL	145	0.5	488	1.6

*Percentages are calculated relative to the total number of accidents reported by the specific category of carrier.

According to these data, differences do exist between the various carrier types. Of interest is that the ICC-regulated carriers reported the lowest incidence of drinking and dozing in accidents.

The issue of alcohol use by heavy truck drivers is considered within the context of safety compliance by Wyckoff (1979). As part of his survey, Wyckoff asked his respondents to indicate prevalent safety violations including speeding, regular use of multiple logbooks, misrepresentation of logbooks, regular exceedence of the 10-hour driving limit, and moving violations. He found that exempt drivers, both company drivers and owner operators were most likely to report any of these violations. Largest proportional differences between exempt and other categories of drivers were associated with reported regular use of multiple logbooks and reported violation of the 10-hour driving limit. In support of these findings, Wyckoff reports that in discussions with trucking company managers, it is generally agreed that "the exempt segment of the industry is relatively undisciplined regarding safety." (Wyckoff, 1979).

In addition to differences between exempt and other categories of drivers, Wyckoff's data reveals differences between owner-operators and company drivers in the regulated sector. Specifically, relative to company drivers, the owner-operators reported proportionately greater use of multiple logbooks, and exceedence of the 10-hour driving limit.

As part of his survey, Wyckoff (1979) asked one question concerning alcohol use. The question asked drivers how long they would wait after drinking before they felt they could drive safely. The responses to this question, presented by category of regulatory status, are shown in the following table.

TABLE 18

Attitude Toward Alcoholic Beverages, Reported by Regulatory Status

(Wyckoff, 1979)

Attitude toward Alcoholic Beverages	Regulatory Status			
	Exempt %	Private %	Contract %	Common %
Do not drink	50.7	49.2	47.5	47.2
Can drive satisfactorily without waiting	5.5	4.5	3.0	1.7
Wait about 1 hour to drive	5.0	2.3	0.9	0.8
Wait about 2 hours to drive	3.0	2.3	1.9	1.5
Wait about 3 hours to drive	2.0	0.8	1.8	0.9
Wait 4 hours or more to drive	33.8	41.0	45.0	48.0
TOTAL	100.0	100.0	100.0	100.0

As indicated, exempt drivers were more willing to drive after alcohol use than other drivers. This was true for each of the categories of time presented in the table.

From these studies, several conclusions can be made. First, based upon the apparent lack of enforcement of the BMCS regulation pertaining to alcohol use there is no evidence to support the conclusion that existence of this regulation per se effectively deters drinking among drivers of heavy trucks.

However, the BMCS reported incidence of drinking by regulated status in combination with Wyckoff's (1979) finding suggests that general safety compliance, including willingness to combine drinking and driving varies according to regulatory status. Specifically, the sources reviewed suggest the regulated segment of the truck industry is generally most safety conscious.

3.4 Solicited Opinions About the Nature of the Problem

As part of the previously mentioned telephone inquiries, comments concerning the nature and circumstances of alcohol use by heavy truck drivers were solicited. A complete discussion of the information obtained is presented in Appendix C. Of particular interest were the comments of Dr. Miller of Human Factors Research, Inc. who, in the course of a study on driver fatigue, developed opinions concerning the various sectors of the heavy trucking industry. Consistent with the findings presented in the previous section, Miller asserted that interstate (regulated) drivers are very safety conscious and not likely to combine drinking and driving. He did, however, speculate that the owner-operators as a group may be more likely to violate BMCS regulations including drinking.

In addition to these specific comments concerning differences between regulated groups, a number of views were expressed about stresses peculiar to truck drivers which were thought to be conducive to drinking*.

- Heavy work loads distort one's family and social life.
- Idle time during layovers away from home is conducive to drinking.

*These views are not attributable to specific individuals.

- The company driver often has an unpredictable work schedule limiting a feeling of control of his own life.

- The owner-operator can be stressed by financial and other business-related concerns. He may drive excessive hours.

- The shorter, routine trips are conducive to familiarity with bars.

Other views included:

- Supervision can be a deterrent to drinking.

- Most drinking occurs at the beginning of layovers.

- Drinking could also be a problem to the extent that it interferes with sleep patterns.

- Some union activities help to prevent drinking, but others may limit the latitude of investigation and/or remediation in specific incidents.

3.5 Alcohol Impairment and the Heavy Truck Driving Task

In the absence of data which allow a specification of the types of accidents to which drinking heavy truck drivers are most susceptible, an examination of components of the driving task was undertaken. The objective was to identify specific skills (e.g., handling) and attentional demands which might be particularly susceptible to the influence of alcohol.

Compared to routine automobile driving, it is generally agreed that the information processing demands and control skills required of heavy truck drivers are more complex (Waller, et al., 1976; Moe, et al., 1973). This is due to the increased size and weight of heavy trucks relative to passenger

cars. Furthermore, because these vehicles are often required to operate in a mixed traffic stream composed primarily of vehicles with quicker response characteristics, drivers of heavy trucks must continuously compensate for the relative awkwardness of their vehicles. This compensation involves increased distance requirements for passing, stopping, turning, and accelerating, which translates behaviorally into more effective anticipation of upcoming situations. As an aid to drivers of heavy trucks, instruction manuals encourage drivers to make use of their relatively high vantage point to anticipate upcoming events by looking over the tops of lead vehicles (Moe, et al., 1973).

Drivers of heavy trucks are also required to monitor informational and advisory signs more closely than drivers of other vehicles. The common example is bridge clearances, which although ordinarily irrelevant to most motorists, must be carefully considered by drivers of heavy trucks. Advisory speeds for upcoming curves ordinarily provide more useful information to heavy truck drivers than to drivers of other vehicles with more than adequate performance characteristics.

In addition to these increased monitoring requirements, the handling of heavy trucks requires more complex skills than is associated with automobile driving. For example, the execution of a right turn has been rated as among the most critical in terms of skill requirements (Moe, et al., 1973). In contrast to the seemingly automatic execution of a right turn by automobile drivers, the execution of such a maneuver with a heavy truck requires a preparatory move to the left and careful monitoring of the right side through the use of mirrors to ensure that no other vehicles attempt to pass on the right during the turn. The criticality of heavy truck handling was documented in a recent engineering study which found that "the typical heavy truck has been found to be capable of eliciting a yaw instability while initiating a turn whose severity is much lower than that needed to achieve limit response of passenger cars." (Ervin, et al., 1976). Other variables such as fifth wheel placement, cargo weight distribution, and the relation of tractor to trailer braking, serve only to compound the difficulties associated with the driving of heavy trucks.

From these examples, it is apparent that the effects of alcohol are more likely to influence the driving of a heavy truck than of a passenger car, given an identical situation. In general, heavy trucks must operate closer to the design limits of both the vehicle and the roadway, the result of which is that smaller margins of error exist, particularly for the recovery of an errant vehicle. Because of the increased attentional demands and the increased precision required of heavy truck drivers, it can be concluded that in almost any driving situation, the effects of alcohol on a heavy truck driver would prove more debilitating than for drivers of other vehicles.

3.6 Integrative Summary of the Heavy Truck Alcohol Problem

To determine the magnitude and nature of the heavy truck alcohol problem, a number of informational sources were considered including published accident and non-accident studies, unpublished analyses of existing data, and solicited opinions of selected knowledgeable individuals within various governmental agencies and within the trucking industry. As expected, the available information was not sufficient to permit definitive conclusions concerning the truck-alcohol problem. With regard to the magnitude of the problem, two categories of published studies were considered. These sources provided inconsistent estimates of the incidence of alcohol use by accident involved heavy truck drivers, leading to the documented conclusion that police officers typically underreport the involvement of alcohol during accident investigations. Differences between the types of accidents sampled were suggested to contribute to the differences in reported drinking involvement.

A search for additional data sources identified NHTSA's FARS data set as potentially useful for determining the extent and nature of alcohol use by fatally injured heavy truck drivers. Analyses of these data identified nine states for which the alcohol test rate was sufficiently high so as to limit potential selection biases. The alcohol involvement rate for fatally injured heavy truck drivers was found to be 19 percent, which is significantly higher than the police reported incidence (approximately 2%) but lower than

that reported by investigators with smaller samples of fatally injured truck drivers (24-35%). Analyses of FARS data for states with test rates of less than 50 percent revealed alcohol involvement of approximately 31%. Finally, based upon the findings presented concerning the general driver-alcohol problem, it was hypothesized that the extent of alcohol involvement among accident-involved heavy truck drivers increases with the severity of the collision. It was estimated that the alcohol involvement rates for property damage, personal injury, and fatal accidents were 5%, 8%, and 19%, respectively.

Information concerning the nature of the truck-alcohol problem was found to be extremely scarce. One study identified single vehicle accidents as a problem for drinking truck drivers. Support for this finding was provided by analyses of FARS data. Analyses of data from a single vehicle accident study documented the characteristics of single vehicle alcohol-involved heavy truck accidents. It was found that these accidents were characterized by small departure angles, no apparent loss of control, and no apparent attempt at corrective action, suggesting a grossly inattentive or sleeping driver.

Analysis of FARS data also revealed that drinking truck drivers were proportionately younger than non-drinking drivers, and more likely to have been convicted of drinking while driving. The characteristics of drinking accidents (e.g., road type, time of day) were found to reflect the patterns of truck driving rather than being specifically related to alcohol involvement.

The use of alcohol by heavy truck drivers was also examined in the context of the structure of the motor carrier industry. The available information suggested that the willingness to combine drinking and driving is related to the driver's regulatory status, such that regulated drivers are typically less likely than exempt drivers to drink before driving.

An examination of the information-processing demands and skill requirements of heavy truck driving led to the conclusion that almost any driving situation requires more attention and finer-tuned skills to maneuver a heavy truck than for an automobile. Alcohol involvement, therefore, was viewed as potentially more dangerous for heavy truck drivers in any situation than for automobile drivers in an identical situation.

4. PROSPECTIVE COUNTERMEASURES FOR THE HEAVY TRUCK ALCOHOL PROBLEM

Although insufficient, the available information suggests that the on-road manifestations of alcohol-impairment are no different for heavy truck drivers than for drivers in general. From the reviews reported in the previous sections, the major commonality appears to be a propensity for single vehicle accidents, which generally involve a road departure and subsequent collision or rollover. Indeed, because of the long periods of continuous driving (often at night) associated with heavy truck operations, and the possible interactive effects of fatigue, drivers of heavy trucks may be especially susceptible to the depressant actions of alcohol, which can result in lowered arousal, lapses of attention, progressive deterioration of tracking performance, and eventual road/lane departure. Alternatively, because the demands of heavy truck driving are generally greater than those associated with control of smaller vehicles, and because alcohol has been found to reduce the overall rate of information processing (Moskowitz and Austin, 1979), impaired truck drivers may also be susceptible to "information overload" when faced with an unexpected increase in task demands, which could lead to confusion and loss of vehicle control.

4.1 Countermeasure Approaches

To address these problems, several CM stategies were identified. The strategies were based upon the objective of reducing the consequences of alcohol-impaired driving. In addition, because heavy truck drivers are generally subject either to BMCS, company, or union regulations prohibiting driving while under the influence of alcohol, strategies which could make use of these regulatory structures for enforcement or detection of alcohol-impaired truck drivers were also considered. Three strategies are discussed briefly:

(1) Arouse impaired driver - To address the progressive deterioration of tracking performance associated with lowered arousal, devices which arouse or startle the driver have been suggested. Implementation could involve in-vehicle devices which monitor driving performance and upon detection of a specified decrement, transmit an alerting stimulus to the driver. Alternatively, roadway implementation could involve use of rumbling shoulder treatments which upon contact with vehicle wheels, cause the vehicle to vibrate. Arousing stimulation, with no specific information content, is hypothesized to be most appropriate for drivers at high BACs who may be unable to interpret specific performance feedback or warning messages.

(2) Alert impaired driver to hazards - At lower or intermediate BACs, or when the impaired driver is able to maintain general alertness, a major impairment effect is a reduced rate of information-processing. Drivers in this condition may be unable to respond appropriately to sudden increases in task demands. Alerting impaired drivers to the existence of a specific hazard is proposed as a possible means of counteracting this type of problem. In-vehicle warning devices along with various roadway alerting devices such as rumble strips on the approach to an unexpected hazard (e.g., with restricted sight distance) and active (flashing) displays are specific examples of CMs intended to alert an impaired driver. This strategy differs from the first in that a more specific message is provided to the driver, concerning on-road hazards.

(3) Deterrence of alcohol-impaired driving - In addition to strategies intended to compensate for or improve the performance of alcohol-impaired drivers, CMs were sought which make use of existing regulations concerning heavy truck operations, so that impaired drivers could be identified either on the road or before their runs begin. Not only could this involve detection of alcohol presence, but also the detection of problem drinkers which might require longer term monitoring of driving records.

4.2 Specific Candidate Countermeasures

CMs with general applicability and no important differences in terms of implementation between heavy truck drivers and the general driving population are considered in Volume I of this report. In this section, CMs identified specifically for addressing the heavy truck alcohol problem are discussed.

4.2.1 In-vehicle Performance Monitoring Devices

The basic concept of performance monitoring and feedback was implemented in a prototype system which was marketed for use in heavy trucks (Moore, et al., 1975). The system (called the Owl system) monitored the steering wheel reversal rate and compared it to a preestablished criterion. If the observed rate was found to deviate significantly from the criterion, a warning tone was sounded to alert (arouse) the driver. Although marketed as a device to counteract drowsiness, the apparent similarity of alcohol impairment and fatigue effects in accidents suggests that such a device may have a common benefit. Unfortunately, problems with the use of steering reversals as a criterion (Huntley, 1973) and the requirement that each system be individually calibrated for each driver have led to the search for more objective criteria for impairment detection. Atwood's (1980, 1979) use of multivariate methods to predict impairment has led him to the conclusion that reliable "on line" detection of alcohol intoxication using control input measurements, although not totally developed, is feasible.

A related issue concerns the type of information to be transmitted to the driver. Laboratory studies which relate information-processing rate to BAC (c.f. Moskowitz and Austin, 1979) can be used to hypothesize that as BAC increases, the complexity of an information presentation which will be effectively used decreases. While mildly impaired drivers may benefit from relatively complex messages, severely impaired drivers probably will respond only to a simple arousing mechanism, if to anything at all. Unfortunately, the potential effectiveness of various types of feedback on the performance of sober and alcohol-impaired drivers is generally unknown. In one study of

measures to counteract fatigue, Snook and Dolliver (1976) found that lateral position feed back improved driver performance, but that speed feedback was of questionable help to fatigued drivers. According to these authors, the technology currently exists to monitor lateral position. Development of performance monitoring devices therefore must identify both the measures which can be reliably used to detect impairment as well as the type of information which could improve the performance of the impaired driver.

An issue of relevance to the implementation of in-vehicle monitoring devices is the use of the information provided by the device. While the original intent of the performance monitoring device was to provide an alerting stimulus to the driver, several alternatives exist. For example, information concerning the existence of an impaired driver could feasibly be transmitted to police to facilitate apprehension. The information could also be used to activate exterior lights on the vehicle so that other motorists would be alerted to a potentially dangerous situation. Finally, such information could be recorded in the vehicle for later use by company or regulatory officials. Obviously, in the interest of immediate accident prevention, feedback to the driver would be potentially most beneficial. However, in the interest of deterrence, use of the same information to prevent subsequent DWI trips could also be beneficial.

4.2.2 In-vehicle Hazard Warning Devices

Existing hazard warning devices utilize radar to detect hazards in the vehicle's path and to sound a warning tone or activate brakes in response. "Non-cooperative" systems refer to vehicle-to-environment radar systems where targets are not specific, as opposed to "cooperative" systems which require a reflective tag on target objects. Using in-depth accident data, Treat (1980) analyzed the benefits of 10 different radar warning and anti-lock braking systems. A non-cooperative radar warning system was judged to have had a certain or probable prevention or severity reduction effect in 16.7% of the 215 collisions analyzed. The warning system combined with a 4-wheel anti-lock braking system

was judged to be potentially beneficial in 38.1% of the sample. Wong, et al. (1976) estimated that radar braking could forestall 18% of all traffic accidents nationwide, thus preventing 15% of all fatalities. According to Flannery, et al. (1976) recent improvements in microprocessor and micro-wave fields have facilitated development of a radar device with significantly improved reliability regarding the detection of hazards in the vehicle's path.

4.2.3 In-vehicle Interlock Devices

Devices which require drivers to demonstrate their capacity to drive by passing a performance test such as the Critical Tracking Task (Tennant and Thompson, 1973) before the vehicle can be started have been considered as a means to discourage alcohol-impaired driving. Despite the many criticisms which surround their potential implementation as a general CM, implementation may be more feasible by trucking firms where vehicles can be started under the supervision of company management.

4.2.4 Breath Tests at BMCS Roadside Safety Checks

The BMCS utilizes roadside safety inspectors to identify vehicles which are in violation of safety regulations. Because alcohol-impaired driving is prohibited by BMCS regulation, it has been suggested that as part of these routine safety checks, drivers be administered breath tests to determine BAC.

4.2.5 Breath Tests at State Truck Weigh Stations

As an alternative to the use of BMCS personnel to detect alcohol presence among heavy truck drivers, the use of state personnel has been suggested.

4.2.6 Identification of Problem Drinkers

Although data are inconclusive, there is some belief that the major alcohol problem among heavy truck drivers involves a relatively small number of problem drinkers. Identification of these individuals has been suggested as a possible means of reducing the incidence of alcohol impaired driving of heavy trucks. The exact method of identification is unknown, but is likely to involve a long term monitoring of driving records by company or union officials.

5. SUGGESTIONS FOR FURTHER RESEARCH AND DEVELOPMENT

Suggestions for each CM identified in the previous sections are presented below.

5.1 In-Vehicle Monitoring Devices

Although implementation may prove to be difficult, the available technical information suggests that performance monitoring and feedback may be beneficial for drivers of heavy trucks who are either alcohol-impaired, fatigued, or both. Specific suggestions follow:

(1) Alert driver to performance decrement - The feasibility of on-line detection of impaired drivers is promising (Attwood, 1979, 1980). However, the effectiveness of arousing/alerting an impaired driver is unknown. An experimental study to evaluate the effectiveness of arousing/alerting mechanisms is, therefore, suggested.

(2) Alert driver to existence of hazard - Such a device exists as part of a radar anti-collision system (Flannery, et al., 1980). Drivers' response to a warning signal is unknown. Research, if possible using an equipped vehicle, to determine a driver's likely response to hazard warning is suggested. Also recommended is the examination of Treat's (1980) methodology which uses in-depth accident data for possible use in evaluating the CM. Evaluation should be coordinated with evaluation of CM #5.

(3) Provide information concerning lane maintenance - The development of alternative presentations of lane position feedback for use in a subsequent experimental study is suggested.

(4) Provide information concerning speed - A more thorough feasibility study is needed to determine what type of speed feedback could be provided and the relevant circumstances.

(5) Non-cooperative radar anti-collision device - Two such prototype devices are known to exist. The feasibility of conducting a closed-course driving study with alcohol-dosed subjects should be examined. (Feasibility depends largely on equipping a vehicle with dual controls, to override the subject's control inputs.) In coordination with CM #2, Treat's (1980) methodology should be examined to determine if examination of in-depth alcohol-involved accidents can be used to assess effectiveness.

(6) Record performance decrement for later use (e.g., periodic review or license renewal) - The feasibility of developing such a device is questionable based upon the preliminary analysis of legal constraints. Further development should await the results of detailed feasibility analyses.

(7) Exterior lights to alert other motorists to performance decrement - The lack of an understanding of how such a device would function, particularly in single-vehicle accidents in combination with the potential legal constraints including violation of vehicle equipment regulations lead to the recommendation to eliminate this CM from further consideration.

(8) Transmit detected performance decrement to police - In addition to unknown technological requirements, the legal feasibility of this CM is questionable. Detailed feasibility analyses should be conducted prior to further development and testing.

5.2 Deterrent Countermeasures

CM's in this category are intended to deter impaired driving. Specific suggestions include:

(9) In-vehicle interlock device - This CM was evaluated as a possible truck CM. Because of the complexity of the trucking industry, implementation of such a CM would require extensive feasibility analyses. Preliminary analyses indicated that such a CM could be feasible for use by a BMCS inspector as a punitive measure. Carriers with unsatisfactory safety records could be required to implement such devices on their vehicles. A more thorough feasibility evaluation is suggested.

(10) Breathalyzer at BMCS roadside safety inspections - This CM was considered the most direct application of existing BMCS regulations to deter drinking among heavy truck drivers. Discussion with BMCS personnel indicated that in addition to the near impossibility of adding additional work to the inspector staff, the implementation of this CM would require rulemaking to establish the authority to administer such tests and to place drivers out of service for refusal or upon positive indication of alcohol. Problems of implementation including use of CB radios by truckers to avoid inspectors were also identified for this CM. For these reasons further development is not recommended.

(11) Breathalyzer at state truck weigh stations - This CM was suggested as a potential alternative to the previous CM. Although the possibility of CB use by truck drivers would threaten the effectiveness, the feasibility of this CM should be examined in greater detail.

(12) Identification of problem drinkers - This CM was intended as a means of obtaining data to support the belief that the major drinking problem among heavy truck drivers involves a few "problem drinkers". The complexity of the industry suggests that obtaining such data would require the cooperation of carriers, unions and other organizations. More thorough feasibility analyses are suggested to determine the availability and methods for collecting and using such data.

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APPENDIX A

DATA COLLECTIONS FOR THE TRUCK-ALCOHOL PROBLEM

Data Collections for the Truck-Alcohol Problem

Background

Because of their mass, heavy trucks in collisions produce large energy transmission conducive to material destruction and a concomitant threat of serious injury or death. The use of alcohol by drivers in the general population has been shown to increase the likelihood of accident generation. Thus, the use of alcohol by drivers of heavy trucks is likely to involve socially and economically unacceptable risks.

Countermeasures reducing the risk can take two forms. One involves the determination of improved means of preventing drinking and driving. The other is based on the development of methods to reduce the likelihood of accidents for drinking drivers. To the extent that the trucking industry is subject to Federal regulation, the implementation of countermeasures of either type may be more practical than are similar efforts directed toward the general driving population.

Yet, in spite of the likelihood of serious risk when truck drivers drink and in spite of the possibilities for control of drinking among regulated truck drivers, little, if any, useful action has been taken to reduce the problem. The most likely reason for this is the paucity of data describing the problem.

In order that remedial activities be well directed, data are needed to guide countermeasure development. Such data must reflect two fundamental aspects of the truck-alcohol problem. First, information describing the magnitude of the problem is required to determine an appropriate level of remedial effort. Second, the nature of the problem must be delineated in order to focus countermeasures where they are most needed and are most likely to be effective.

While currently available data have shed some light on the role of alcohol in truck safety, there are a number of difficulties precluding an accurate specification of the truck-alcohol problem.

- To date, the only reasonably reliable alcohol detection methods involve breath or blood testing. Judgmental methods typically used by the police to indicate drinking have not been shown to be reliable; furthermore, there is no assurance that they are uniformly applied.

- Even when chemical testing is employed, the resultant data may be seriously biased due to the lack of uniformity in selecting drivers to be tested. For example, BAC distributions derived from drivers in accidents reflect only drivers for which alcohol tests were performed; these drivers may not be representative of all accident drivers.

- While the requirement for uniform testing has been recognized as a prerequisite for unbiased estimation of the magnitude of the drinking problem, little critical attention has been given to the parallel prerequisite for unbiased estimation of the nature of the alcohol problem, specifically that selection of drivers for testing be independent of the nature of the accident.

- As a result of the driver selection and alcohol detection problems, reliable alcohol usage data are currently available only for well-selected fatally injured accident drivers. The quality of drinking incidence data for survivors of fatal accidents, drivers in personal injury or property damage accidents, and drivers not in accidents is questionable at best. (While some apparently reliable data have been collected for accident survivors and non-accident drivers, no such information is available for drivers of heavy trucks.)

- Even for fatally injured drivers, data are seriously limited. The number of accidents for which reliable alcohol-use information is available is small. Beyond that, currently available information on the nature of the accidents, the vehicles, the drivers, and the related trucking operations is insufficient to allow anything approaching a comprehensive delineation of the nature of the truck-alcohol problem.

Statement of the Problem

In order to determine an appropriate level of effort for countermeasure development and to determine countermeasure targets, improved information is needed on the heavy truck-alcohol problem.

Because current data, with few exceptions, fail to provide sufficient specification of both the magnitude and nature of the truck-alcohol problem, it is virtually impossible to single out individual areas in need of improved documentation. Rather, there is a need for good data pertaining to essentially all aspects of the truck-alcohol problem; only with such data can critical needs and commensurate remedial efforts be determined.

For this reason, a single, focused data collection is not recommended. Rather, what is needed is a multifaceted approach covering the general area. Figure B-1 is one structuring of information areas based on our experience in the information search for the current project.

Applicable Driver Population	Aspect of the Problem: Magnitude	Aspect of the Problem: Nature
Fatally Injured		
Accident Survivors		
Non-Accident		

Figure A-1

The magnitude of the problem refers to the incidence of driving and/or accident involvement after drinking. The nature of the problem may be described in terms of driver, vehicle, and truck operations associated with drinking; this, too, may refer to driving, per se, or to accident involvement. In the latter case, information on accident characteristics is also needed.

Because little is known about truck accident characteristics, there is a wide variety of data which could be usefully collected. Major categories include driver, trip, vehicle, and situational characteristics, and descriptions of how the accidents occurred. Generally speaking, police reports with reliable BAC's would provide a data base similar to FARS and would be quite useful if available for nonfatal accidents. However, this could be significantly improved upon if more detailed information in the categories noted above were included. Elements such as driver experience with heavy trucks, familiarity with the road, hours driven this trip, hours driven in the last week, time elapsed since sleeping, familiarity with the vehicle type, vehicle type, width and weight are needed as are situational characteristics such as road alignment, number of lanes, lane width, road signing and traffic control devices. Also required are data describing the role of the truck in the accident generation process. As a minimum, accidents should be classified according to Perchonok's (1978) accident configurations. However, improved data assuring the reliability of the descriptions and the reasons for accident-involving behaviors would allow more discriminating analyses as would information on accident avoidance maneuvers.

Thus, rather than relying on standard police reports, a more desirable procedure would include the use of a supplemental form to be completed by the investigating police. If required by the items on such forms, a special police training session could be provided; if the forms were simple, written instructions might suffice, although this should require justification. Although not necessarily essential, selected photographs can often heighten the reliability of accident data.

Finally, if feasible, it would be desirable to obtain information pertaining to drinking prior to the accident - amount, over what period of time, time elapsed since the last drink, and the conditions in which the drinking occurs.

In order that any data collected accurately represent real-world problems, particular attention must be given in any data collection plan to the reliability of alcohol detection methods and procedures for driver selection. Specifically, unless other methods can be shown to be reliable, alcohol use must be detected by chemical means. Secondly, drivers must be selected and tested in ways which are independent of alcohol use and driver, vehicle, truck operations, and accident characteristics.

Required Data Collections

Some data collections designed to meet the above criteria are discussed below for each of the six matrix cells in Figure B-1 as needed. Because of variety of approaches required, their feasibility and limitations have not been assessed. As such, they are not recommendations for implementation but rather ideals for further evaluation.

Magnitude - fatally injured drivers. Of the six matrix cells, this one is the best documented. Data from FARS for high test rate states provide relatively good information on BAC distributions. While a more complete picture of the U.S. as a whole or of separate sections of the country would be obtainable if many of the states had increased alcohol test rates, currently available information suggests priorities for improved data be placed in other cells of the matrix.

Nature - fatally injured drivers. FARS also provides relatively reliable data for this area of inquiry. However, these data suffer from (1) a limited number of applicable accidents, and (2) limited detail for each accident.

The number of accidents available for study could be expanded in two ways. First, the Traffic Injury Research Foundation in Ottawa maintains a similar data base for selected Canadian provinces. If it can be shown that these data can be used to draw conclusions applicable to the U.S., the two data sets can be used jointly. The number of FARS heavy truck accidents could also be expanded if the number of states with high alcohol test rates could be increased; this, of course, would depend on the willingness and ability of the states to do so. The feasibility of this approach would require determination of states thought to be amendable to improved alcohol testing rates, recommendations from current high test rate states as to the means to do so, and discussions with candidate states as to the feasibility of doing so.

Regarding the amount of detail for FARS accidents, this may be amenable to expansion if FARS heavy truck accident data from high test rate states could be merged with BMCS accident data. In this way, reliance could be placed on the FARS data for drinking status while additional information on the drivers, the vehicles, and truck operations would be provided from BMCS reports. To the extent that the number of cases existing in both files may be a limiting factor; this approach would benefit from attempts mentioned above to increase alcohol test rates of fatally injured drivers in the states.

Magnitude and nature - accident surviving drivers. The most critical problem in obtaining useful data about accident survivors is the requirement for reliable alcohol detection procedures. Beyond that, driver selection for testing becomes an issue. The most practical means for determining the driver's drinking status is police use of partable field breath testers.

If a state could be found where sufficient numbers of field testers are available (or could be Federally provided), the state police are willing, and the law provides for breath testing of accident drivers, it may be possible to obtain a sufficiently high test rate to provide useful data. This approach has an inherent risk in that its implementation, in itself, may lower the drinking rate thereby distorting resultant statistics. This effect could be detected, however, if the state were one of the high test rate states for fatally injured drivers; then drinking rate decrements would be detectable among these nonsurviving drivers. In such circumstances, the data collection methodology itself could qualify as a useful countermeasure.

For the purposes of the question at hand, the testing of accident drivers could be limited to drivers of heavy trucks. This would keep the scope of testing activities to a limited scale. There is a question, however, as to the legality of this discrimination. On the other hand, it may be possible that there are states willing to conduct comprehensive testing within limited geographic areas. This approach would also reduce the number of alcohol testers required.

Finally, this approach would require an examination of the reliability of portable breath testers and a determination of the reliability required for useful data.

An alternate approach for the problem of providing useful data for accident survivors might involve the determination of the means to improve BMCS accident reporting in terms of frequency, completeness, and reliability. The feasibility of this approach would require investigation of the current reporting system to determine if there is a reasonable expectation of improving it. The current lack of "teeth" behind BMCS reporting requirements does not provide reason for optimism. Preliminary inquiries might be sufficient to determine the likely value of this approach.

Magnitude and nature - nonaccident drivers. It has been suggested that alcohol use among nonaccident truck drivers could be determined via breath testers at truck weigh stations. The method could involve temporary testing stations set up for short durations so as to minimize the warning of other drivers via CB communications. As with procedures discussed above, to enhance the test rate of accident survivors, interested states would need to be located, and legal issues resolved. Additionally, logistics allowing efficient short-term deployments would require investigation.

Finally, it would be appropriate to examine the utility of such non-accident data. Specifically, the question is whether such data can be used to nail down the heavy truck-alcohol problem as directly as accident data can. It should also be noted that if this approach could be properly implemented in georgraphic areas with high test rates of truck drivers in accidents, then the effects of BAL on accident risk in the form of accident rates could be determined.

APPENDIX B

TABLES OF ACCIDENT FACTORS FOR FATALLY INJURED DRINKERS VERSUS NON-DRINKERS - TRUCK AND OTHER VEHICLES

(Source: Fatal Accident Reporting System [FARS].)

TABLE B-1

Driver Age

DRIVER AGE	Trucks					Other Vehicles				
	Nondrinker		Drinker		% Drinker	Nondrinker		Drinker		% Drinker
	N	%	N	%		N	%	N	%	
≤25	49	15.2	9	12.3	15.5	2788	40.8	4526	46.9	61.9
26 - 35	104	32.3	32	43.8	23.5	1232	18.0	2511	26.0	67.1
36 - 55	130	40.4	27	37.0	17.2	1286	18.8	1907	19.8	59.7
≥56	39	12.1	5	6.8	11.4	1520	22.3	699	7.2	31.5
Subtotal	322	100.0	73	100.0		6826	100.0	9643	100.0	
Unknown	0		0			12		11		
TOTAL	322		73			6838		9654*		

Drinking truck drivers vs. nondrinking truck drivers: Chi-square = 4.29 on 3 df (NS)

Drinking truck drivers vs. drinking drivers of other vehicles: Chi-square = 38.15 on df (S)

*Total received from FARS deviated slightly from those for other tables.

TABLE B-2

Presence of Passengers

Presence of Passengers	Trucks					Other Vehicles				
	Nondrinker		Drinker		% Drinker	Nondrinker		Drinker		% Drinker
	N	%	N	%		N	%	N	%	
No	250	78.9	57	78.1	18.6	4405	65.0	6380	66.4	59.2
Yes	67	21.1	16	21.9	19.3	2369	35.0	3229	33.6	57.7
Subtotal	317	100.0	73	100.0		6774	100.0	9609	100.0	
Unknown	0		0			0		3		
TOTAL	317		73			6774		9612		

Drinking truck drivers vs. nondrinking truck drivers: Chi-square = 0.02 on 1 df (NS)

Drinking truck drivers vs. drivers of other vehicles: Chi square = 4.44 on 1 df (S)

TABLE B-3

Previous DWI Convictions

PREVIOUS DWI CONVICTIONS	Trucks					Other Vehicles				
	Nondrinker		Drinker		% Drinker	Nondrinker		Drinker		% Drinker
	N	%	N	%		N	%	N	%	
Yes	14	4.5	6	8.7	30.0	226	3.5	1412	15.5	86.2
No	296	95.5	63	91.3	17.5	6191	96.5	7684	84.5	55.4
Subtotal	310	100.0	69	100.0		6417	100.0	9096	100.0	
Unknown	7		4			357		516		
TOTAL	317		73			6774		9612		

Drinking truck drivers vs. nondrinking truck drivers: Chi-square = 1.97 on 1 df (NS)*

Drinking truck drivers vs. drinking drivers of other vehicles: Chi-square = 2.44 on 1 df (NS)

*This table, and some that follow, contain a low expected value. Low expected values tend to increase the Chi-square statistic, but none of these tables yielded a significant result.

TABLE B-4

Number of Vehicles Involved

NUMBER OF VEHICLES INVOLVED	Trucks					Other Vehicles				
	Nondrinker		Drinker		% Drinker	Nondrinker		Drinker		% Drinker
	N	%	N	%		N	%	N	%	
Single Vehicle	198	62.5	58	79.5	22.7	2305	34.0	6288	65.4	73.2
Multivehicle	119	37.5	15	20.5	11.2	4469	66.0	3324	34.6	42.7
TOTAL	317	100.0	73	100.0		6774	100.0	9612	100.0	

Drinking truck drivers vs. nondrinking truck drivers: Chi-square = 7.60 on 1 df (S)

Drinking truck drivers vs. drinking drivers of other vehicles: Chi-square = 6.32 on 1 df (S)

TABLE B-5

Relation to Junction

RELATION TO JUNCTION	Trucks					Other Vehicles				
	Nondrinker		Drinker		% Drinker	Nondrinker		Drinker		% Drinker
	N	%	N	%		N	%	N	%	
Nonjunction	271	86.3	63	86.3	18.9	4557	69.8	7807	82.8	63.1
Intersection	43	13.7	10	13.7	18.9	1974	30.2	1620	17.2	45.1
Subtotal	314	100.0	73	100.0		6531	100.0	9427	100.0	
Driveway	3		0			242		184		
Unknown	0		0			1		1		
TOTAL	317		73			6774		9612		

Drinking truck drivers vs. nondrinking truck drivers: Chi-square = 0.00 on 1 df (NS)

Drinking truck drivers vs. drinking drivers of other vehicles: Chi-square = 0.62 on 1 df (NS)

TABLE B-6

Manner of Collision

Manner of Collision	Trucks					Other Vehicles				
	Nondrinker		Drinker		% Drinker	Nondrinker		Drinker		% Drinker
	N	%	N	%		N	%	N	%	
Rear End	42	41.6	3	21.4	6.7	472	11.0	371	11.7	44.0
Head On	20	19.8	3	21.4	13.0	1452	33.7	1404	44.5	49.2
Angle	25	24.8	7	50.0	21.9	2134	49.6	1168	37.0	35.4
Sideswipe	14	13.9	1	7.1	6.7	245	5.7	215	6.8	46.7
Subtotal	101	100.0	14	100.0		4303	100.0	3158	100.0	
Rear to Rear	0		0			9		7		
Not Applicable	216		59			2455		6445		
Unknown	0		0			7		2		
TOTAL	317		73			6774		9612		

Drinking truck driver vs.nondrinking truck drivers: Chi-square = 4.53 on 3 df (NS)

Drinking truck drivers vs. drinking drivers of other vehicles: Chi-square = 3.41 on 3 df (NS)

TABLE B-7

Day of Week

DAY OF WEEK	Trucks					Other Vehicles				
	Nondrinker		Drinker		% Drinker	Nondrinker		Drinker		% Drinker
	N	%	N	%		N	%	N	%	
Monday	51	16.1	12	16.4	19.0	916	13.5	885	9.2	49.1
Tuesday	55	17.4	12	16.4	17.9	954	14.1	870	9.1	47.7
Wednesday	50	15.8	6	8.2	10.7	889	13.1	977	10.2	52.4
Thursday	56	17.7	13	17.8	18.8	840	12.4	1078	11.2	56.2
Friday	58	18.3	18	24.7	23.7	1100	16.2	1503	15.6	57.7
Saturday	29	9.1	8	11.0	21.6	1074	15.9	2232	23.2	67.5
Sunday	18	5.7	4	5.5	18.2	1001	14.8	2067	21.5	67.4
TOTAL	317	100.0	73	100.0		6774	100.0	9612	100.0	

Drinking truck drivers vs. nondrinking truck drivers: Chi-square = 3.83 on 6 df(NS)

Drinking truck drivers vs. drinking drivers of other vehicles: Chi-square = 28.66 on 6 df (S)

TABLE B-8

Day of Week

DAY OF WEEK	Trucks					Other Vehicles				
	Nondrinker		Drinker		% Drinker	Nondrinker		Drinker		% Drinker
	N	%	N	%		N	%	N	%	
Weekdays	270	85.2	61	83.6	18.4	4699	69.4	5313	55.3	53.1
Saturday & Sunday	47	14.8	12	16.4	20.3	2075	30.6	4299	44.7	67.4
TOTAL	317	100.0	73	100.0		6774	100.0	9612	100.0	

Drinking truck drivers vs. nondrinking truck drivers: Chi-square = 0.12 on 1 df (NS)

Drinking truck drivers vs. drinking drivers of other vehicles: Chi-square = 23.47 on 1 df (S)

TABLE B-9

Light Condition

Light Condition	Trucks					Other Vehicles				
	Nondrinker		Drinker		% Drinker	Nondrinker		Drinker		% Drinker
	N	%	N	%		N	%	N	%	
Daylight	172	57.3	31	43.1	15.3	4261	65.8	2225	24.1	34.3
Dark	128	42.7	41	56.9	24.3	2218	34.2	7017	75.9	76.0
Subtotal	300	100.0	72	100.0		6479	100.0	9242	100.0	
Dawn or Dusk	17		1			287		338		
Unknown	0		0			8		32		
TOTAL	317		73			6774		9612		

Drinking truck drivers vs. nondrinking truck drivers: Chi-square = 4.77 on 1 df (S)

Drinking truck drivers vs. drinking drivers of other vehicles: Chi-square = 14.02 on 1 df (S)

TABLE B-10

Time of Day

TIME OF DAY	Trucks					Other Vehicles				
	Nondrinker		Drinker		% Drinker	Nondrinker		Drinker		% Drinker
	N	%	N	%		N	%	N	%	
Midnight - 2:59 AM	27	8.5	17	23.6	38.6	541	8.0	2997	31.4	84.7
3 AM - 5:59 AM	61	19.2	9	12.5	12.9	322	4.8	946	9.9	74.6
6 AM - 8:59 AM	38	12.0	4	5.6	9.5	814	12.0	258	2.7	24.1
9 AM - 11:59 AM	50	15.8	5	6.9	9.1	918	13.6	195	2.0	17.5
Noon - 2:59 PM	42	13.2	7	9.7	14.2	1107	16.4	455	4.8	29.1
3 PM - 5:59 PM	35	11.0	12	16.7	25.5	1370	20.3	1009	10.6	42.4
6 PM - 8:59 PM	28	8.8	8	11.1	22.2	915	13.5	1584	16.6	63.4
9 PM - 11:59 PM	36	11.4	10	13.9	21.7	774	11.4	2099	22.0	73.1
TOTAL	317	100.0	72	100.0		6761	100.0	9543*	100.0	

Drinking truck drivers vs. nondrinking truck drivers: Chi-square = 21.55 on 7 df (S)

Drinking truck drivers vs. drinking drivers of other vehicles: Chi-square = 19.81 on 5 df (S)**

*Totals received from FARS deviated slightly from those for other tables.

**Rows 3, 4, and 5 were combined.

TABLE B-11

Road Surface Conditions

ROAD SURFACE CONDITION	Trucks					Other Vehicles				
	Nondrinker		Drinker		% Drinker	Nondrinker		Drinker		% Drinker
	N	%	N	%		N	%	N	%	
Dry	253	80.6	61	83.6	19.4	5645	83.8	8216	86.2	59.3
Wet	46	14.6	8	11.0	14.8	849	12.6	1089	11.4	56.2
Ice or Snow	15	4.8	4	5.5	21.1	241	3.6	227	2.4	48.5
Subtotal	314	100.0	73	100.0		6735	100.0	9532	100.0	
All Other	3		0			30		43		
Unknown	0		0			9		37		
TOTAL	317		73			6774		9612		

Drinking truck drivers vs. nondrinking truck drivers: Chi-square = 0.70 on 2 df (NS)

Drinking truck drivers vs. drinking drivers of other vehicles: Chi-square = 2.96 on 2 df (NS)

TABLE B-12

Land Use

LAND USE	Trucks					Other Vehicles				
	Nondrinker		Drinker		% Drinker	Nondrinker		Drinker		% Drinker
	N	%	N	%		N	%	N	%	
Urban	67	21.1	16	21.9	19.3	2974	43.9	3910	40.7	56.8
Rural	250	78.9	57	78.1	18.6	3800	56.1	5702	59.3	60.0
TOTAL	317	100.0	73	100.0		6774	100.0	9612	100.0	

Drinking truck drivers vs. nondrinking truck drivers: Chi-square = 0.02 on 1 df (NS)

Drinking truck drivers vs. drinking drivers of other vehicles: Chi-square = 10.58 on 1 df (S)

TABLE B-13

Road Type

ROAD TYPE	Trucks					Other Vehicles				
	Nondrinker		Drinker		% Drinker	Nondrinker		Drinker		% Drinker
	N	%	N	%		N	%	N	%	
Urban:										
Interstate	45	14.3	9	12.3	16.7	399	6.0	578	6.2	59.2
Major Route	17	5.4	4	5.5	19.0	1169	17.6	1623	17.4	58.1
Local Street	5	1.6	3	4.1	37.5	1404	21.2	1698	18.2	54.7
Rural:										
Interstate	91	29.0	19	26.0	17.3	466	7.0	518	5.6	52.6
Major Route	156	49.7	38	52.1	19.6	3188	48.1	4894	52.6	60.6
Subtotal	314	100.0	73	100.0		6626	100.0	9311	100.0	
Urban:										
Other	0		0			2		8		
Unknown	0		0			0		3		
Rural:										
Local Road	1		0			51		113		
Other	2					85		167		
Unknown	0		0			10		10		
TOTAL	317		73			6774		9612		

Drinking truck drivers vs. nondrinking truck drivers: Chi-square = 2.23 on 4 df (NS)

Drinking truck drivers vs. drinking drivers of other vehicles: Chi-square = 56.69 on 3 df (S)*

*Urban and rural interstates were combined to increase expected frequencies.

APPENDIX C

INFORMED OPINION ON THE TRUCK-ALCOHOL PROBLEM

Informed Opinion on the Truck-Alcohol Problem

To supplement other sources of information about a possible truck-alcohol problem, telephone inquiries were made of individuals likely to be knowledgeable on the subject. Agencies represented in these discussions included (1) governmental agencies, (2) research organizations, (3) carriers, truckers, and trucking associations, and (4) insurance companies.

The types of information sought in these discussions can be described in terms of three dimensions. First, we were interested in both the magnitude and the nature of the possible truck-alcohol problem. The magnitude would include, for example, information pertaining to the effects of alcohol on accident rates, and the frequency with which alcohol is indicated in accidents or non-accident driving. The nature of the problem, on the other hand, refers to characteristics of truck accidents involving alcohol, characteristics of drinking drivers, characteristics of trucking operations conducive to drinking, etc.

The second dimension refers to the basis of the information. Specifically, we were interested in subjective assessments of the truck-alcohol problem as well as in actual data. The major reasons for this were twofold. First, we were concerned about a potential dearth of relevant hard data. To the extent that this was indeed found to be the case, it was felt that subjective assessments might provide backup information for the specification of the truck-alcohol problem. Secondly, certain types of information are more likely to be found via appeal to opinion as opposed to typical data analysis. Included here are (1) views of factors in the trucking industry which impact upon the alcohol problem, and (2) subjective appraisals of previous research, governmental actions, etc.

The third dimension refers to the source of the information. That is, while the early part of each discussion was directed toward information directly available to the discussant, the latter part involved recommendations of other sources of objective and/or subjective information pertaining to the magnitude and/or nature of the truck-alcohol problem.

Information derived from these discussions is presented below. A separate section has been written for each agency category. Following introductory explanations, findings are presented within the following categories.

I. Data available on the magnitude of the truck-alcohol problem

II. Subjective assessments of its magnitude

III. Data available on the nature of the truck-alcohol problem

IV. Subjective assessments of its nature

(1) Agency Category: Governmental

Discussions were held with federal agencies in the U.S. and Canada and with three states. The federal agencies of both countries provided information pertaining to data sources and recommendations of other agencies and individuals which might be useful sources of information. Foremost regarding the latter were the Bureau of Motor Carrier Safety and the Contract Technical Manager from NHTSA's Office of Driver and Pedestrian Research; they provided most of the initial listing of agencies to be contacted.

The most useful data source located in our information search was NHTSA's Fatal Accident Reporting System (FARS) file. While the FARS data were under examination but before results were available, discussions were held with three states regarding the utility of their accident files. While all were quite cooperative, it was determined from FARS analysis that two of the three states did not have sufficiently high alcohol testing rates to limit potential biases in the data of interest.*

* The importance of alcohol test rates is discussed more fully in Section II of the main body of this report.

It was further determined that sufficiently high test rates could be found only for data pertaining to fatally injured drivers. Because of this, because of the ready accessibility to FARS, because most of the state data on fatal accidents appears in FARS, and because an individual state has only a limited number of fatal heavy truck accidents, it was decided to focus our analytical efforts on the FARS file.

Findings

I. Magnitude: Data

NHTSA's FARS data file is the best source of information located in the information search. Because of the importance of findings derived from analysis of the FARS data, the results are described in Section II of the main body of this report.

II. Magnitude: Subjective

Some subjective assessments of the magnitude of the truck-alcohol problem were received from persons familiar with accident data. However, the referenced data were not collected with particular interest in the alcohol problem. In one instance, there was a reference to knowledge of one or two apparently alcohol-induced heavy truck catastrophic accidents. Another source indicated two or three incidents of drinking among 150 heavy truck drivers in accidents. Also indicated were concerns for underreporting of drinking among accident drivers by police investigators.

III. Nature: Data

The above comments pertaining to FARS are also applicable here. See Section II in the main body of the report for findings.

IV. Nature: Subjective

No relevant findings were determined in this category.

Agencies Contacted

U.S. Government
- Bureau of Motor Carrier Safety
- Interstate Commerce Commission
- National Highway Traffic Safety Administration
- National Transportation Safety Board

Canadian Government
- Canadian Ministry of Transportation and Communications
- Department of Transportation

U.S. States
- California Highway Patrol
- New York Department of Motor Vehicles
- Pennsylvania Department of Transportation

(2) Agency Category: Research Organization

Various research groups have compiled data relevant to the role of alcohol in heavy truck accidents through projects primarily concerned with other objectives. Each of these projects has approached the relationship of alcohol to truck safety from a somewhat different perspective. Since published materials are reviewed elsewhere in this report, unpublished data and researchers' opinions are presented here.

Some data of interest were gathered by Mackey and Miller (1978) of Human Factors Research, Inc. in the course of a study entitled "Effects of Hours of Service, Regularity of Schedules and Cargo Loading on Truck and Bus Driver Fatigue". The results of this project contain data from several physiological, subjective, and performance measures. Of particular value to the truck-alcohol problem are the results of a questionnaire on drivers' off-duty behavior that included items pertaining to the consumption of alcohol. Their questionnaires were completed on each work day

by six company drivers for three weeks and by six other company drivers for two weeks. The data from these reports have not been summarized but are available upon request. The primary limitation of these data is the extremely small sample size. A further limitation is the fact that the data cannot be directly related to truck accidents. However, some conclusions about truck safety might be drawn from the data by relating the questionnaire information to the physiological and performance measures used in the study.

One of the findings of this research project is that the probability of a truck driver being involved in an accident is increased when the driver has been behind the wheel for five or more consecutive hours and also during the early morning pre-dawn hours of 4:00 to 6:00 AM. The results also indicate that peak accident rates occur when these two conditions exist simultaneously. Dr. Miller speculates that driver consumption of alcohol would exacerbate the effects of extended driving time and early morning hours on accident rates. Furthermore, the effects of extended driving time and early morning hours suggest the importance of recovery sleep in the prevention of truck accidents. This observation prompted Dr. Miller to infer that accident rates would also be affected to the extent that the consumption of alcohol interferes with sleep patterns and the acquisition of adequate recovery sleep.

In addition, this research also enabled Dr. Miller to formulate some subjective impressions of the way in which truck drivers are likely to use alcohol and how their use of alcohol is likely to impact on truck accidents. As is true of the questionnaire data, these observations apply only to company operators. According to Dr. Miller, interstate carriers seem to be very safety conscious and appear to be just as conscientious about not drinking and driving. Dr. Miller also feels that most local unions support company contracts that specify drinking and driving as grounds for dismissal. In addition, the pattern of drinking identified most often by Dr. Miller does not involve the trucker drinking before going to work; rather, it appears as if the drivers tend to drink just after work and use the alcohol as a means of relaxation.

Finally, while this research project was not concerned with owner-operators, Dr. Miller suggests that, as a group, owner-operators may be more likely than company drivers to drink and drive. This hypothesis is based on two observations: first, the owner-operators are subject to less controls than the company drivers in that the former group does not have any contract with either company safety supervisors or dispatchers; the second, owner-operators have an incentive to push themselves beyond their limits to the extent that they earn more money for more miles driven. Both of these conditions would seem to be conducive to drinking and driving.

A second research effort that helps define the role of alcohol in heavy truck accidents consists of the data organized by the Highway Safety Research Institute. These data reflect a compilation of information gathered by 39 different research teams that investigated a total of 324 different truck accidents. For each accident, a maximum of two factors could be indicated as impairing the driver's ability to drive. Some of the relevant percentages are presented in Table C-1. In this table, "drinking" is broadly defined and represents those cases in which drinking to any extent was considered to impair ability to drive. The data show that drinking comprises 3.4% of the total possible number of factors that could have been indicated as impairing the driver's ability to drive. Since it is likely that drinking could have been indicated as a factor a maximum of one time for each accident, it is reasonable to conclude that drinking is indicated in 6.8% of the 324 accidents that were investigated. While this information provides some indication of the magnitude of the truck-alcohol problem, its accuracy is suspect due to the probable lack of uniformity among the 39 participating research teams in regard to reporting criteria and procedures.

TABLE C-1.

Driver's Ability to Drive Impaired by:

Factor	Frequency	%
Unknown	77	11.9
None	461	71.1
Drinking	22	3.4
Medication	0	0.0
Drugs	1	0.2
Other	87	13.4
Total	648	100.0

List of Contacts

Human Factors Research, Inc., Goleta, California

Dr. Daryl Wyckoff, Harvard University

Highway Safety Research Institute, University of Michigan

Traffic Injury Research Foundation, Ottawa

Ms. Susan Baker, Johns Hopkins University

Insurance Institute for Highway Safety, Washington, D.C.

Liberty Mutual Research Center, Hopkington, Massachusetts

Addiction Research Foundation, Toronto

Findings

I. Magnitude: Data

The questionnaire results obtained by Mackey and Miller provide an estimate of the amount of alcohol consumed on a daily basis by a small group of truck drivers over a short period of time. This information has not yet been summarized. A more direct measure of the magnitude of the role of alcohol in truck accidents is provided by the data compiled by HSRI. These statistics indicate that in 6.8 percent of 324 investigated truck accidents, the driver's ability to drive was considered to be impaired by his use of alcohol.

II. Magnitude: Subjective

Although none of the individuals contacted cared to make any quantitative estimates, most speculated that the actual involvement of alcohol in heavy truck accidents is of a greater magnitude than that which has been indicated on paper.

III. Nature: Data

The results of the questionnaire used by Mackey and Miller might be useful in describing the nature of the truck-alcohol problem in two ways. First, the effects of hours of service and regularity of schedules on daily drinking habits could be ascertained. Second, inferences about the role of alcohol in truck safety could be made by examining the relationship between reported use of alcohol and the physiological and performance measures used in the study. However, if the data were to be summarized in these ways, the utility of the information would be limited by the small sample size used in the study.

IV. Nature: Subjective

The only subjective observations made about the nature of the relationship of alcohol on truck safety were those of Dr. Miller. Included here is a reiteration of his comments about company drivers. (1) In general, interstate drivers are very conscientious about not drinking and driving. (2) Local unions are typically supportive of company efforts to deter drivers from drinking on the job. (3) Drivers that do drink tend to do so just after work in order to relax. (4) The use of alcohol may exaccerbate the detrimental effects of extended driving time and early morning hours on accident rates. (5) Owner-operators may be more likely than company drivers to drink and drive because they do not come into contact with safety supervisors and company dispatchers and because they work with an incentive to push themselves by driving an excessive number of hours in order to make more money.

Conclusion

Each of the research projects described above is a potential source of some information about the magnitude and nature of alcohol involvement in truck accidents. However, the actual usefulness of the data available for definitively describing the truck-alcohol problem is limited in each case. Perhaps the reason for this is that the studies were not designed to specifically focus on the role of alcohol in truck accidents.

(3) Agency Category: Carriers, Trucking Associations, and Professional Drivers

Description:

The information in this section is based on conversations with safety personnel from several carriers, representatives of various trucking associations, and individual professional drivers. The common element shared by individuals from each of these three categories is a high degree of famialiarity with the trucking industry. Consequently, the primary usefulness of the obtained information is the description of the truck alcohol problem as specified by the opinions of the individuals contacted. In regard to data, even though major carrier lines apparently maintain files of accident reports completed by company representatives and independent insurance adjustors, these files are generally not accessible to people outside of the company.

On the whole, the remarks made by the individuals contacted reflect a broad range of perceptions of the truck-alcohol problem. Since each of the people has spoken from a vantage point founded upon his own accumulated experience, there are inconsistencies and even contradictions among stated opinions that derive from the variability of experience among individuals. Because of this, in paraphrasing viewpoints the format used attempts to maintain the purity of individual ideas while presenting them in an organized manner. In addition, also because of the subjective nature of the acquired information, statements by individuals were neither designed nor interpreted to be representative of the organizations with which they are affiliated. As a result, individual statements are presented anonymously.

List of Contacts

I. Carriers

Consolidating Freightways
McLean Trucking
Roadway Express
Yellow Freight Systems

Lion's

United Parcel Service

Hall's Trucking

Hoy Transfer

II. Trucking Associations

American Trucking Association

American Brotherhood of Teamsters, Chaufeurs, Warehousemen, and Helpers of America

Pennsylvania Motor Truck Association

Professional Driver Council

III. Professional Drivers

Lincoln Merrill

Ted Brooks

Findings

I. Magnitude: Data

No relevant information.

II. Magnitude: Subjective

There is substantialy variability among subjective estimates of the incidence of alcohol involvement in heavy truck accidents. In general, these estimates are not expressed in quantifiable terms: rather, they seem to reflect intuitive feelings about whether or not alcohol is a problem in truck safety. Most appraisals suggest that alcohol involvement in truck accidents is minimal. On the other hand, a minority of the individuals contacted suggested that the incidence of alcohol involvement in heavy truck accidents is actually greater than that which has been documented. Taken together, direct estimates of the magnitude of the truck-alcohol problem allow for the conclusion that either the problem is minimal or it is very difficult to verify.

Some inferences about the magnitude of alcohol involvement in heavy truck accidents might be made by analyzing statements concerned with but not directly related to the problem. One individual approached the truck-alcohol problem by focusing upon alcoholism within the profession as an index of the magnitude of the problem. His opinion follows.

> The prevalence of alcoholism among truckers is probably about the same as or even lower than that for the general population.

Another indirect assessment of the magnitude of the truck-alcohol problem can be based on a comparison of alcohol with other drugs as factors in truck accidents. One statement made in this vein follows.

> I suspect that in comparison to the use of alcohol, driver use of pills is more likely to be a factor in heavy truck accidents.

Along this line, a different individual not only felt that drugs are involved in more truck accidents than alcohol, but also elaborated on some of the dimensions of drug abuse among truckers.

> In particular, a lot of young drivers use marijuana and cocaine; and amphetamines are still used by some drivers who feel it necessary to overextend themselves in regard to driving time.

These comments tend to indicate limited use of alcohol; on the other hand, the last two reflect a shift of emphasis to drugs.

A feature common to nearly all of the appraisals of the magnitude of alcohol involvement in heavy truck accidents is the vagueness and lack of specificity characterizing the estimates. Several of the officials contacted speculated about the reasons for this lack of clarity. One factor frequently cited concerns police reporting. Most individuals felt that police tend to underreport alcohol involvement in truck accidents for a variety of reasons. Some statement to this effect follow.

> It's not very likely that you'll be able to find good data about the involvement of alcohol in truck accidents. This is because most police officers are aware that if they indicate that a trucker has been drinking and driving, the driver will lose his ICC license. In general, police don't like to destroy a man's livelihood. I know of a few cases in which the police were apparently aware that the driver had been drinking, but did not indicate the involvement of alcohol on any written form.

> Police often underreport the involvement of alcohol in an accident because they are likely to be in a hurry to investigate an accident, get it out of the way, and attend to other business.

> One source of police underreporting of drinking among truck drivers is the fact that the members of some local police departments belong to the Teamsters Union.

In contrast to these sentiments were the opinions of a minority of individuals that police were more vigilant about drinking among truckers in comparison to the general population.

> In terms of drinking and driving, I feel that the police are stricter with truckers compared to other drivers.

> Police officers are more anxious to cite truck drivers as opposed to automobile drivers for driving while under the influence.

At any rate, the accuracy of the police reports in regard to alcohol involvement in accidents is unreliable according to several of the individuals contacted. This lack of reliability, in turn, precludes conclusive evaluations of the magnitude of the truck-alcohol problem.

In addition, judgments by carriers about the extent of alcohol involvement in truck safety are complicated by at least two issues. First of all, at times union protection of drivers allegedly interferes with the company's ability to determine or indicate whether a driver has been drinking on the job.

A second issue that may interfere with the validity of magnitude estimates is the willingness of the carrier to share information that is potentially harmful to its public image. As a result, certain considerations with which carriers are concerned detract from their ability to assess and specify the magnitude of the truck-alcohol problem.

In summary, estimates of the magnitude of the truck-alcohol problem tend to be inconsistent and vague. Most appraisals suggest that the involvement of alcohol in truck accidents is minimal. A few individuals feel that the problem is greater than it appears but this is difficult to verify. None of the statements concerning magnitude are very specific; apparently, this is partly attributable to problems with police reports and to the carriers' inability to make objective, accurate estimates.

III. Nature: Data

No relevant information.

IV. Nature: Subjective

Several of the individuals contacted described the nature of the truck-alcohol problem by identifying conditions that increase the likelihood of a driver drinking. Some of the factors associated with drinking include the driver's work schedule, the length of the driver's trips, and the employment situation of the driver. A profile of opinions delineating the influence of these variables is presented below.

To begin with, the driver's work schedule has an impact that permeates several dimensions of his life. Several of the people contacted felt that the trucker's work situation can be a source of stress to the driver physically, socially, and emotionally. A comprehensive summary of this effect is described below.

> Drinking among truck drivers may often be a response to several forms of stress engendered by the work demands with which a trucker must cope. Most company drivers are not only on the road an inordinate number of hours each week but are also on-call during those periods of time that they are at home. Consequently, several truckers work a very crowded and irregular schedule.
>
> One of the effects of such job demands over an extended period of time is an accumulated fatigue from which the driver might try to escape through the use of alcohol. In addition, the accumulated fatigue might increase the driver's use of amphetemines. This, in turn, could lead the driver to use alcohol as a means of controlling the effects of the amphetemines.
>
> Another strain produced by the trucker's work situation impacts on the driver's social life. Since the driver is away from home often and on-call when he is at home, he does not have the opportunity to maintain consistent social contacts. Furthermore, the social contacts that truckers experience on the job tend to be negative and confrontive in nature. The net result may be strain due to social contacts that are limited in frequency and often disparaging in nature. This kind of strain may enhance the likelihood of drinking among drivers.
>
> Finally, a crowded and unpredictable work schedule leaves the truck driver feeling that he is rarely free from the demands of his job and that he does not have much control over his personal life. The ensuing frustration and resentment may, in turn, enhance the likelihood of drinking.

Another statement elaborates on the potential effect of the driver's extended absences from home.

> The trucker's work schedule requires him to be frequently separated from his family. This in itself, increases the likelihood of drinking as well as the frequency of domestic problems. The latter, in turn, enhances the probability of drinking by the driver.

One specific way in which drinking may interact with a driver's work schedule is indicated by the following observation.

> Drivers are likely to drink when they are just off the road at the beginning of a layover. In this situation, it's very important to be able to relax and go to sleep quickly. Alcohol is useful towards this end.

Another situation in which drinking and driving may be influenced by scheduling is described below.

> A company driver may be called to work during a layover, while he is drinking. This does not occur very often, though.

Finally, the significance of the role of the driver's schedule in drinking is highlighted by the following remark.

> There is very little evidence of an alcohol problem among our [company] drivers. One of the major reasons for this is the fact that our drivers work eight-hour days and are at home each night.

In summary, the professional driver's work schedule is thought to be very demanding in several respects, and drinking can be the driver's response to the stress of these demands. Schedules that require the driver to work an excessive number of hours at irregular intervals and spent a lot of time away from home are felt to be particularly hard to handle. In this respect, the schedule that a trucker works and the way in which he copes with it may be major determinants of the extent to which the professional driver drinks.

Like work schedule, whether a driver typically makes long versus short hauls might also influence the likelihood of drinking. Some of the individuals contacted felt that long hauls were most conducive to drinking. Two of these remarks follow.

> Long-haul drivers face certain conditions that seem to be conducive to drinking. Two aspects of long layovers are particularly important. First of all, long layovers involve strain stemming from the driver's separation from his home and family. Second, long layovers leave the driver with a lot of idle time in an unfamiliar environment. Such a situation enhances the attractiveness of drinking as a means of passing the time.

On long hauls, boredom may be conducive to drinking. One person expressed a different point of view.

> The likelihood of a driver drinking is affected by the length of his trips. A short-haul driver that runs a one or two day familiar relay is likely to drink simply because he's familiar with the bars along his route. On the other hand, long-haul drivers seem to be more concerned about the risks that drinking and driving entails and, as a group, are more conscientious.

These two statements taken together appear to differ regarding the affects of trip length on drinking. However, they may suggest different factors conducive to drinking apply in long versus short trips.

As discussed earlier, a driver's work load is likely to be associated with probability of drinking. In this regard, nearly all of the individuals contacted agreed that the owner-operator is likely to push himself to work an inordinate number of hours for business reasons. Drinking may be a response to the resulting strain. Some statements to this effect follow.

> The company driver must abide by the ceiling for consecutive driving time imposed by the ICC; the owner-operator can disregard the regulation by faking his log. So, to make more money, the owner-operator may push himself beyond his physical and emotional limits. Drinking is more likely under these conditions.

> Company drivers typically work a relay system. This system requires a driver to go from Terminal A to Terminal B, rest for eight hours, and then return to Terminal A. The manageability of the workload minimizes the need to drink.

So, it appears as though the owner-operator is more likely to drink than the company operator to the extent that he must cope more often with the strain of overwork.

Likewise, the probability of drinking is considered to be higher among owner-operators in comparison to company drivers as a result of close supervision for the latter group. Some statements describing the role of supervision are presented below.

> The primary deterrent to drinking among company drivers is supervision. For example, a driver arriving at a company terminal files a vehicle report with garage personnel and then proceeds to the dispatcher's office. These contacts with company employers function as restraints on drinking behavior because if he's suspected of drinking, he can be checked.

> Because of the relative absence of supervision for independent owner-operators, drinking and driving is probably more common among the owner-operators in comparison to company drivers.

> Drinking among company drivers is even further limited in those states where company safety supervisors are permitted to test drivers for alcohol consumption. Driver knowledge of this possibility is an effective deterrent.

While the effect of supervision is to minimize drinking and driving among company drivers, the actual effectiveness of supervision is diminished by certain factors. A description of some of these factors follow.

> Even for the major carriers, the degree of actual supervision could be limited at small terminals, and on long hauls with layovers the opportunity for drinking certainly exists.

> Garage personnel are not an effective deterrent to drinking simply because they're not concerned about or attentive to the drivers.

> Safety supervisors are not consistent with one another in their attitudes about drinking by drivers.

> Many drivers respond to supervision with anger rather than with compliance.

In summary, then, while supervision may deter company drivers from drinking it is certainly not a panacea for the truck-alcohol problem because its effectiveness is often limited.

In general, since the relative frequency that a specific point of view is expressed is a function of the particular sample of people contacted, relative frequencies do not necessarily reflect reality. With this caveat in mind, the vast majority of the individuals contacted considered drinking and driving to be much more prevalent among owner-operators as opposed to company drivers. At least one opinion was equivocal, though.

> We employ both company drivers and contract with independent owner-operators to carry special commodities. It's hard to say whether drinking is more prevalent among one group or the other. The owner-operator is working for himself, so he has more to lose than the company driver by drinking and driving. On the other hand, the company driver is subject to more checks through his contacts with dispatchers and safety supervisors.

In addition, a very small minority of the individuals contacted felt that owner-operators are less likely to drink than company drivers.

> Since the owner-operator owns his own rig, he has a lot more to lose if he wrecks or has his license taken away. He not only loses his job, but also a business in which he is heavily invested. So, the owner-operator is typically more cautious than the company driver.

On the whole, however, most observers considered the owner-operator to be more likely than the company driver to drink because of his tendency to over work and because of the relative absence of supervision of him.

On the basis of the opinions offered by representatives of carriers, trucking associations, and professional drivers, it is difficult to conclusively identify the specific conditions that increase the likelihood of a driver drinking. Certain inferences of a tentative and limited nature, however, can be drawn. First, to the extent that job stress is related to drinking, truckers whose schedules demand excessive work time, irregular hours, and extended separations from home may be likely to drink. Second, trip length seems to influence drinking in a manner than cannot be specified on the basis of the information available. Third, in comparison to the company driver, the owner-operator may be more likely to drink because of the excessive number of hours that he tends to work and because of the relative lack of supervision to which he is subjected.

Conclusion

The information acquired through conversations with officials from carrier lines and trucking associations and from individual professional drivers is entirely subjective in nature. As such, the views expressed are sometimes contradictory, often inconsistent, usually biased, and always tentative. The principal value of the obtained information is to indicate areas warranting further inquiry. A major shortcoming of the opinions expressed is that much of the information does not focus directly on the role of alcohol in heavy truck accidents. In fact, many of the opinions do not even directly reflect the incidence of truckers' drinking on the job. Instead, some of the observations

are restricted to the likelihood of a trucker drinking in general. Therefore, much of the information is useful in defining the truck-alcohol problem only if it can be assumed that there is a positive relationship among the following three variables for truckers: the likelihood of drinking in general, the probability of driving while under the influence, and the probability of an accident.

Given these considerations, the following summary statements can be derived from the opinions expressed by the individuals contacted.

1. Estimates of the magnitude of the truck-alcohol problem are inconsistent and vague.

2. Many appraisals minimize the involvement of alcohol in truck accidents.

3. There is some indication that magnitude of the problem is actually greater than it appears because the incidence of drinking is difficult to verify and document.

4. Estimates of magnitude lack specificity, possibly because of problems with police reports and carriers' inability to appraise the problem accurately and objectively.

5. If job stress is positively related to drinking, then there is an increased likelihood of drinking for the driver whose work schedule requires excessive work time, irregular hours, and frequent separation from home.

6. Drivers tend to drink when they are just off the road at the beginning of a layover as a means of relaxation.

7. The effects of trip length on drinking are unclear. Different factors may influence drinking on long versus short hauls.

8. If the likelihood of drinking is related to level of job satisfaction, the following relationships may exist: owner-operators that are susceptable to business-related stress are apt to drink as are independently-minded company operators.

9. Manageability of workload and driver supervision tend to disminish the likelihood of drinking among company drivers compared to owner-operators.

10. Owner-operators are considered to drink and drive more often than company operators; this finding may reflect sampling biases.

(4) Agency Category: Insurance System

The insurance system appears to offer a potential source of information regarding the role of alcohol in truck accidents. In particular, the adjustors' reports seem as though they may provide data that reflects both the magnitude and nature of the relationship between alcohol and truck safety. However, the actual value of these reports is seriously limited by concerns about the validity of the information in the reports and by the inaccessibility of the reports themselves.

List of Contacts

I. Self Insured Carriers
   McLean Trucking
   Roadway Express

II. Specialty Insurance Underwriters
   Carriers
   Transit Casualty
   Transport
   Transport Indemnity

III. Independent Insurance Adjustors
   Gay and Taylor
   Crawford and Company

Findings

I. Magnitude: Data

Data relating to the magnitude of the truck-alcohol problem are recorded on the accident reports completed by independent insurance adjustors. These reports are on file at large, self-insured carrier lines, adjustors' branch offices, and the home offices of Specialty Insurance Underwriters. A

(5) Agency Category: Miscellaneous

A number of agencies not fitting specific categories were also contacted. While expressing interest in the issue and in one instance providing literature on the general drinking driver problem, the representatives of these agencies had no relevant data nor subjective assessments specific to the truck-alcohol problem.

Agencies Contacted

American Association for Automotive Medicine
Distilled Spirits Council of the USA
International Association of Chiefs of Police
National Safety Council
National Sheriffs Association