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TRI-LEVEL STUDY OF THE CAUSES OF TRAFFIC ACCIDENTS: FINAL REPORT

Volume I: Casual Factor Tabulations and Assessments

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16. Abstract

This is the Final Report of the "Tri-Level Study of the Causes of Traffic Accidents," performed by the Indiana University Institute for Research in Public Safety (IRPS), under contract to the National Highway Traffic Safety Administration (Contract No. DOT-HS-034-3-535). Several Interim and special investigation reports have been released previously.

Volume I provides causal result tabulations from Phases II through V, and related analyses. Volume II presents several special analysis reports dealing with driver vision, knowledge, psychological make-up, etc. Phase I data differed in format, and were presented in a previous report.

Data were collected on three levels of detail. Police reports and other baseline data on the Monroe County, Indiana study area were collected on Level A. On Level B, teams of technicians responded to accidents at the time of their occurrence to conduct on-scene investigations; a total of 2,258 investigations were conducted during Phases II through V. Concurrently, 420 of these accidents were independently examined by a multidisciplinary team on Level C. Other special surveys were also conducted.

One or more human factors was cited by the in-depth team as a probable cause in 92.6% of accidents investigated in Phases II through V. Environmental factors were cited as probable causes in 33.8% of these accidents, while vehicular factors were identified as probable causes in 12.6%. The major human direct causes were improper lookout, excessive speed, inattention, improper evasive action, and internal distraction. Leading environmental accident causes were view obstructions and slick roads. The major vehicular causes of accidents were brake failure, inadequate tread depth, side-to-side brake imbalance, under-inflation, and vehicle related vision obstructions.

Vision (especially poor dynamic visual acuity) and personality (especially poor personal and social adjustment) were found related to accident-involvement. However, as measured in this study, knowledge of the driving task was not shown to be related.

17. Key Words	18. Distribution Statement
Traffic accident causes; driver errors; roadway design, maintenance and signing; vehicle defects, maintenance and inspection; driver vision testing; driver knowledge test; multidisciplinary crash research.	Availability is unlimited. Documents may be released to the public through the National Technical Information Service, Springfield, Virginia 22151.

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None	None		

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METRIC CONVERSION FACTORS

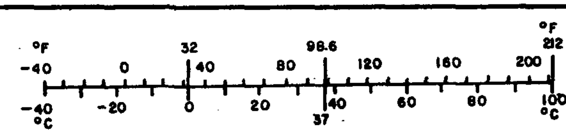
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in ≡ 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



ACKNOWLEDGEMENTS

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Special thanks are extended to the Monroe County law enforcement agencies, whose daily cooperation was necessary in permitting our investigators to collect data at accident scenes, to utilize police radio frequencies, to acquire copies of police accident reports, and to acquire information from daily activity logs. These include the Bloomington Police Department, under the direction of Chief Carl L. Chambers; the Monroe County Sheriff's Department, under the direction of Sheriff William H. Brown and his predecessor, Sheriff Clifford R. Thrasher; the Indiana State Police, under Superintendents Robert L. DeBard and Robert K. Konkle, and Post Commander Lt. Forest V. Cooper; and the Indiana University Safety Division, under George E. Huntington, Director. The extent of cooperation of these agencies was truly remarkable; dispatchers often called to provide accident notification, and officers sometimes even held accident scenes to permit the necessary marking and measuring of physical evidence. It is doubtful that law enforcement agencies anywhere have provided any higher level of support to a research endeavor of this kind. Again, our sincere thanks.

Aside from access to accident scenes and vehicles, nothing was more critical than access to the persons involved in accidents, which brought our investigators in frequent contact with the Bloomington Hospital and Indiana University Health Center, and in need of their support. Such cooperation was very willingly provided, and for this reason we are indebted to the doctors, nurses, and staffs of both of these facilities. At the Bloomington Hospital, special thanks go to Mr. Roland E. Kohr, Administrator; Dr. Robert M. Walker, M.D., head of the emergency room; and Mrs. Debra D. Jerden, R.N., emergency room supervisor.

We are also indebted to the Indiana Bureau of Motor Vehicles for providing driver violation histories on each driver involved in accidents investigated by our multidisciplinary team, at no charge. Special thanks go to Mr. Ralph Van Natta, Commissioner, and to Mrs. Joyce E. Bubb, in charge of the records section.

Our thanks are also extended to the Monroe County License Branch, and to its manager, Mr. Carl M. Myers, for permitting project personnel to sample demographic data from the local driver license files on several occasions.

We also wish to thank the R.L. Polk and Company for providing vehicle registration data on the city, county, state and nation at no charge, and for permitting this data to be reproduced in these reports.

The current project staff also wish to acknowledge the contributions of the many individuals who were involved with the project in its earlier stages. Among these was Mr. Kent B. Joscelyn, who as Institute director and co-principal investigator from the project's inception in 1972 through 1975, played a key role in acquiring the project and in providing both administrative and technical support. (He is now with the University of Michigan's Highway Safety Research Institute.)

The project staff wish in addition to acknowledge the many contributions of Jody A. Vaught, who has been in charge of clerical support to the project throughout, and who has personally typed many of the forms and reports produced under it, including interim reports, the present final report, and many of the 420 in-depth case reports which were prepared. She has, of course, been supported by many other fine individuals. Particular thanks are extended to Rebecca J. Ammon, who was responsible for typing materials emanating from several of the special studies associated with the project. Other members of the IRPS clerical staff supporting preparation of this report have included Cynthia S. Banta, Deborah S. Grubb and Debra L. Ingalls. Our thanks to each one.

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As project director, I would also like to acknowledge the contributions of my colleagues in authoring individual sections. These individuals and the sections for which they bore primary responsibility are as follows: John Castellan—Cluster Analysis (additional work by David Shinar); Rex Hume—AID Analysis; Richard Mayer—Driver Knowledge and Driver Psychological Factors; Stephen McDonald—Driver Culpability Analysis, Motorcycle Cause Analysis, and Data Representativeness; David Shinar—Driver Vision Testing, Conditions and States vs. Other Causal Factors, Accident Causation Practices, On-Site vs. In-Depth Analysis, and General Discussion; Rickey Stansifer—Vehicle Causation Appendix; and Nicholas Tumbas—View Obstruction Appendix. Support in editing was provided by Kathy Moseman and Phil Cornwell. Working with these people has been a pleasure.

John R. Treat
March, 1977

TRI-LEVEL STUDY OF THE CAUSES OF TRAFFIC ACCIDENTS: FINAL REPORT

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TRI-LEVEL STUDY OF THE CAUSES OF TRAFFIC ACCIDENTS: FINAL REPORT

VOLUME I Causal Factor Tabulations and Assessments
Report No. DOT-HS-034-3-535-77-TAC
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TRI-LEVEL STUDY OF THE CAUSES OF TRAFFIC ACCIDENTS: FINAL REPORT

VOLUME I Causal Factor Tabulations and Assessments
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1.0 Introduction

This is the final report of a three-year research program entitled "Tri-Level Study of the Causes of Traffic Accidents," performed by the Institute for Research in Public Safety (IRPS) of the Indiana University School of Public and Environmental Affairs. The study was performed for the National Highway Traffic Safety Administration (NHTSA), U.S. Department of Transportation, under Contract No. DOT-HS-034-3-535. The period of performance was from 15 August 1972 to 30 September 1975,[1] which coincides with IRPS data collection Phases III, IV, and V. Phase II data, acquired under a previous NHTSA contract (1),[2] are also reported. Phase I data appear in a previous report (1).

1.1 Research Objectives

The study was conducted to satisfy a broad range of NHTSA's needs for up-to-date data regarding traffic accident causation. The basic research question was "what causes traffic accidents?," and all potentially causative factors — human, vehicular, and environmental — were of interest. Accomplishment of this overall objective involved several specific objectives, including the following:

1. Identify those factors which are present and serve to initiate or influence the sequence of events resulting in a motor vehicle accident (Vol. I).
2. Determine the relative frequency of these factors and their causal contribution within a defined accident and driving population (Vol. I).
3. Assess the error/accident relationship as a function of driver age, driving knowledge, vision, driving experience, and vehicle familiarity (Vol. II).
4. Apply taxonomy development and group-identification concepts to the identification and definition of problem driver types, and from this to formulate recommendations for dealing with particular classes of drivers (particular attention was to be given to the alcohol-impaired driver, in order to identify the types of driving-performance mistakes made by particular types of alcohol-impaired drivers under particular types of conditions). (Vol. II).
5. Assess the potential benefit of radar and anti-lock braking systems in reducing the incidence and severity of automobile accidents (See Interim Report II, Vol. II).
6. Develop new methodologies for assessing the role of human factors in accident causation. (Vol. II).

[1] Later extended to June, 1977 for supplemental analysis tasks, to be separately reported.

[2] Numbers in parentheses refer to references which are listed near the end of this volume.

1.2 Report Structure

This final report is comprised of two volumes. Volume I reports causal factor tabulations and assessments, while Volume II reports several special analyses based on project data.

Several earlier (interim) reports of this three-year study have been published; in chronological order, these include:

- *Tri-Level Study of the Causes of Traffic Accidents: Interim Report I, Vols. I & II.*

  Prepared under Contract No. DOT-HS-034-3-535, August 1973, DOT Report Nos. HS-801-334 and HS-801-335. This was a final report of the first year of activity under the present three-year program. It provided causal factor tabulations for Phase III, as well as cumulative results for Phases II and III. Volume I included methodology, conclusions, and recommendations sections; causal result tabulations; comparisons of Phase II and III results; assessments of accident severity as a function of causal factor; an analysis of the model year distribution among vehicles involved in accidents as a result of vehicular problems; a comparison of results obtained on-site and in-depth; a comparison of accident and control sample populations; results of an initial cluster analysis effort; an assessment of relationships between various driver, accident and causal factor characteristics; and an assessment of the representativeness of study samples. The glossary section of Volume I included the overall causal hierarchy and causal factor definitions. Volume II provided a more detailed description of methodology, as well as the principal data collection forms and the detailed causal result data tables (2).

- *Tri-Level Study of the Causes of Traffic Accidents: Interim Report II, Volumes I & II.*

  Prepared under Contract No. DOT-HS-034-3-535. Volume I dated August, 1974; Volume II dated December, 1974 (Nos. HS-801-968 and HS-801-631). These were final reports of the second year of activity. Volume I provided a report of causal result tabulations and trends, while Volume II dealt exclusively with assessments of the potential payoff of radar warning, radar actuated, and anti-lock braking systems in preventing accidents or reducing their severity. Causal result data in Volume I included both Phase IV and cumulative Phase II, III, IV data. A third document (Volume III) was produced but not published. Instead, its contents were updated and incorporated in the present final report. It dealt with results of dynamic vision testing, driver knowledge testing, on-site and in-depth cluster analyses of data, an AID analysis relating driver characteristics and accident causes, and new methodology development, including profile scores of drivers (3).

The present document is a comprehensive final report of the three-year study. However, not all materials previously published have been replicated herein. For example, results of the radar/anti-lock assessments (Interim Report II, Volume II) are not included. The present report includes causal factor tabulations from the Phase V collection period, as well as cumulative data from Phases II through V.

Prior to the present study, IRPS was engaged in a related tri-level study under NHTSA sponsorship, entitled "A Study to Determine the Relationship Between Vehicle Defects and Crashes" (DOT-HS-034-2-263). In chronological order, relevant documents from that study were:

- *Interim Report of A Study to Determine the Relationship Between Vehicle Defects and Crashes: Methodology.*

  Prepared under Contract No. DOT-HS-034-2-263, November, 1971. DOT Report No. DOT-HS-800-661. Provides details of tri-level methodology. This document was produced during Phase I of IRPS' several data collection phases (4).

- *Results of a Study to Determine the Relationship Between Vehicle Defects and Crashes, Vols. I & II.*

  Prepared under Contract No. DOT-HS-034-2-263, November, 1972. DOT Report Nos. DOT-HS-800-850 and 851. Provided results from data collection Phases I and II. Although the emphasis was on the role of vehicular factors, human and environmental factors were also tabulated in a manner consistent with that employed in later phases. Volume I provided causal result tabulations, while Volume II dealt with comparisons of component outage rates in the accident and general vehicle populations, comparisons of results obtained at the on-site and in-depth levels, and the representativeness of study samples. The report was a product of data collection Phase II (1).

1.3 Status of Accident Investigation and Data Collection Activities

As described in the methodology overview (Volume I, section 2.0), a tri-level methodology has been employed featuring baseline data collection on Level A, on-site investigations of moderate detail on Level B, and in-depth investigations of intensive detail on Level C.

During Phase V IRPS continued to build both baseline and accident data files (Tables

1-1 and 1-2). Baseline data includes information describing Monroe County accidents reported to the state (location, date, etc.), drivers licensed in Monroe County (age, sex, vision as measured by the dynamic vision tester, etc.), vehicles registered in Monroe County (make, model, year, etc.), and Monroe County roadways (miles of surfaced and unsurfaced roads, etc.).

Throughout Phase V, twenty-four hour per day coverage was maintained on Level B, permitting a sizeable increase in the accident data files. An additional 894 on-site (Level B) and 102 in-depth (Level C) investigations were conducted, bringing the total for the three-year study to 1728 on-site and 269 in-depth. These data are generally compatible with those collected during Phase II (530 on-site, 151 in-depth) providing a total base of 2258 on-site and 420 in-depth accidents readily available for analysis. Also during Phase V, information was acquired on all 3068 Monroe County accidents reported to the state during this period, bringing the total number of state accident reports for the Phase II-V period to 13,568 (Table 1-2).

1.4 Background

The National Highway Traffic Safety Administration (NHTSA) has sponsored a variety of accident investigation studies since 1968. These studies to collect and analyze real-world accident data provide a foundation for development of safety strategies, rule-making plans, assignment of priorities, and measures of the effectiveness of countermeasure programs at the national level. Thus, the critical real-world data developed provide a technical base for intelligent planning and decision-making. In summary, specific objectives of the national accident investigation system are to:

- Identify the causes and mechanisms of motor vehicle accidents and subsequent injuries, so that effective measures, devices, and traffic safety programs can be initiated.
- Provide accident information and analyses on priority safety problems for research and rule-making.
- Assess the worth of motor vehicle and highway safety standards now in force, and predict the potential effectiveness of new standards under consideration.
- Pinpoint defects in motor vehicles or highway design as the basis for scientific investigation.
- Validate advanced accident investigation techniques in the field to improve the precision, accuracy, and efficiency of the collection of accident data while reducing the collection burden of on-scene investigators.

Table 1-1

Summary of Baseline Data Collected by IRPS

Phase	File Name	File Description	Data Collection Period (source)	No. of Sampling Units	No. of Variables	Sampling Technique
PHASE II	PH2E30	Age and sex of Monroe Co. licensed drivers	May, 1972 (1971 driver's license applications)	1,061	3	Systematic sampling from a list
	ISP71	Monroe Co. Police reported accident data	April, 1972 (ISP)	3,914	56	Entire population
PHASE III	PH3E30	Age and sex of Monroe Co. licensed drivers	May, 1973 (1972 driver's license applications)	1,000	3	Systematic sampling from a list
	PH3E31	Make & model year of Monroe Co. passenger vehicles	June, 1973 (1973 Monroe Co. passenger vehicle registrations)	2,000	2	Systematic sampling from a list
	PH3E09	Monroe Co. driver-vehicle characteristics	29 April, 1973 to 3 June, 1973 (Monroe Co. drivers)	300	43	Quota sampling (stratified by age and sex)
	ISP72	Monroe Co. police reported accident data	April, 1973 (ISP)	3,272	56	Entire population
PHASE IV	PH4E30	Age and sex of Monroe Co. licensed drivers	April, 1974 (1973 driver's license applications)	980	10	Systematic sampling from a list
	PH4E60	Monroe Co. licensed driver vision	8 April, 1974 to 8 July, 1974 (Monroe Co. licensed drivers)	149	70	Quota sampling (stratified by age and sex)
	PH4E61	Monroe Co. licensed driver vision test-retest	8 April, 1974 to 8 July, 1974 (Monroe Co. licensed drivers)	51	112	Quota sampling (stratified by age and sex)
	PH4E62	Monroe Co. licensed drivers	August, 1974 (Indiana BMV)	63,000	16	Entire population
	PH4E63	Monroe Co. registered vehicles	June, 1974 (Indiana BMV)	33,921	35	Entire population
	ISP73	Monroe Co. police reported accident data	April, 1974 (ISP)	3,314	56	Entire population
PHASE V	PH5E30	Age and sex of Monroe Co. licensed drivers	July, 1975 (1974 driver's license applications)	2,081	18	Systematic sampling from a list
	ISP74	Monroe Co. police reported accident data	April, 1975 (ISP)	3,068	56	Entire population

Table 1-2

Summary of Accidents Investigated by IRPS Using Tri-Level Methodology

Data Collection Phases & Dates	Police Reports (Level A)	On-Site (Level B)	In-Depth (Level C)
I—10/70-5/71	3458 in 1970	'469	68
II—6/71-5/72	3914 in 1971	530	151
III—6/72-5/73	3272 in 1972	306	64
IV—6/73-5/74	3314 in 1973	528	103
V—6/74-5/75	3068 in 1974	894	102
Combined Phases[1] II, III, IV, V	13,568	2258	420

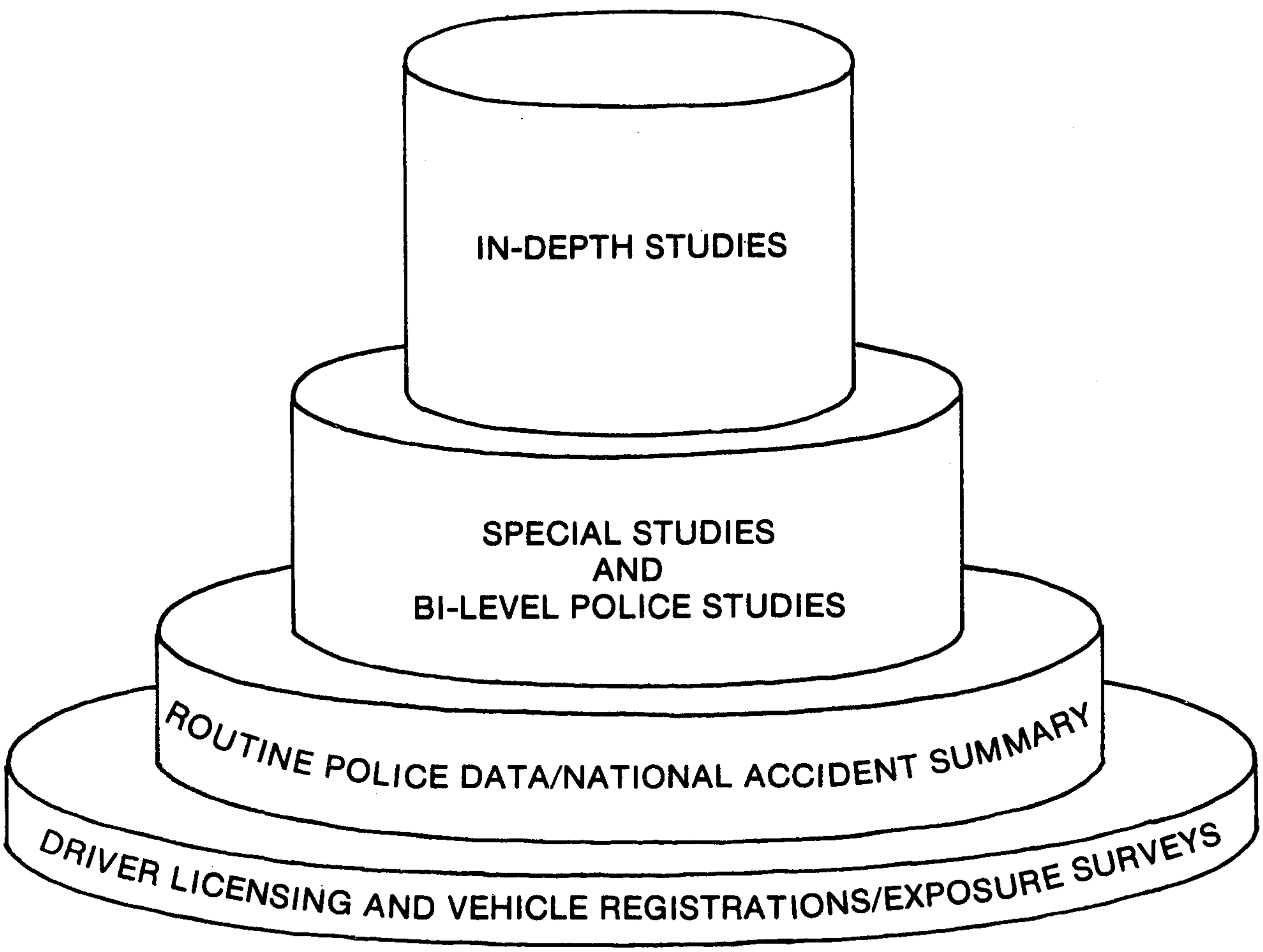
[1] Phases II, III, IV, and V were assessed using the same causal assessment scheme, and are presented both separately and cumulatively. Phase I differed somewhat and, for the most part, is not reported herein.

Recent trends in accident research have led to a multilevel approach to national accident data collection, processing and analysis (see Figure 1-1). The level of sophistication ranges from population data and the basic, minimal amount of data contained in routine police reports of all accidents, to the most comprehensive, in-depth data contained in special reports by professional accident investigation teams. In the basic level of collection, a small number of data elements are collected on the population at large and on a large number of accidents. Data from vehicle registrations and drivers licenses are utilized as supplement information at this basic level. At the top level, hundreds of data elements are collected on a small number of select accidents which are designated for study. Intermediate levels involve various additional data elements not routinely collected at the basic level in order to study some specific aspect on a subsample of accidents.

A composite approach, designated as a **tri-level study,** was devised from this multilevel national concept. Tri-level studies involve simultaneous accident data collection and investigation from three levels of detail, within a single study. Thus, **the three levels of the IRPS tri-level program, in order of increasing detail and cost per investigation and decreasing case volume are:**

- The collection of baseline data on the study county from police reports, vehicle registration files, driver license files, roadway inventories, and local surveys (Level A).

Figure 1-1 — Multi-Level Concept



ACCIDENT DATA COLLECTION AND ANALYSIS

Diagram Courtesy of NHTSA.

- The on-site investigation of accidents immediately following their occurrence by teams of technicians (Level B).
- The independent, in-depth investigation of a subset of the accidents investigated on-site, by a multidisciplinary team (Level C).

Data collected on Level A enable the representativeness of study samples to be assessed, and also provide a basis for comparison of accident and general populations. The Level B (on-site) investigations enable moderately detailed information to be collected from a relatively large number of accidents. Since the extension of coverage in February, 1974 from 10 hours to 24 hours per day, IRPS has acquired accidents on Level B at the rate of approximately 70 to 80 accidents per month (840 to 960 per year). On Level C, a multidisciplinary team has conducted highly-detailed investigations at a rate which has averaged about 100 accidents per year.

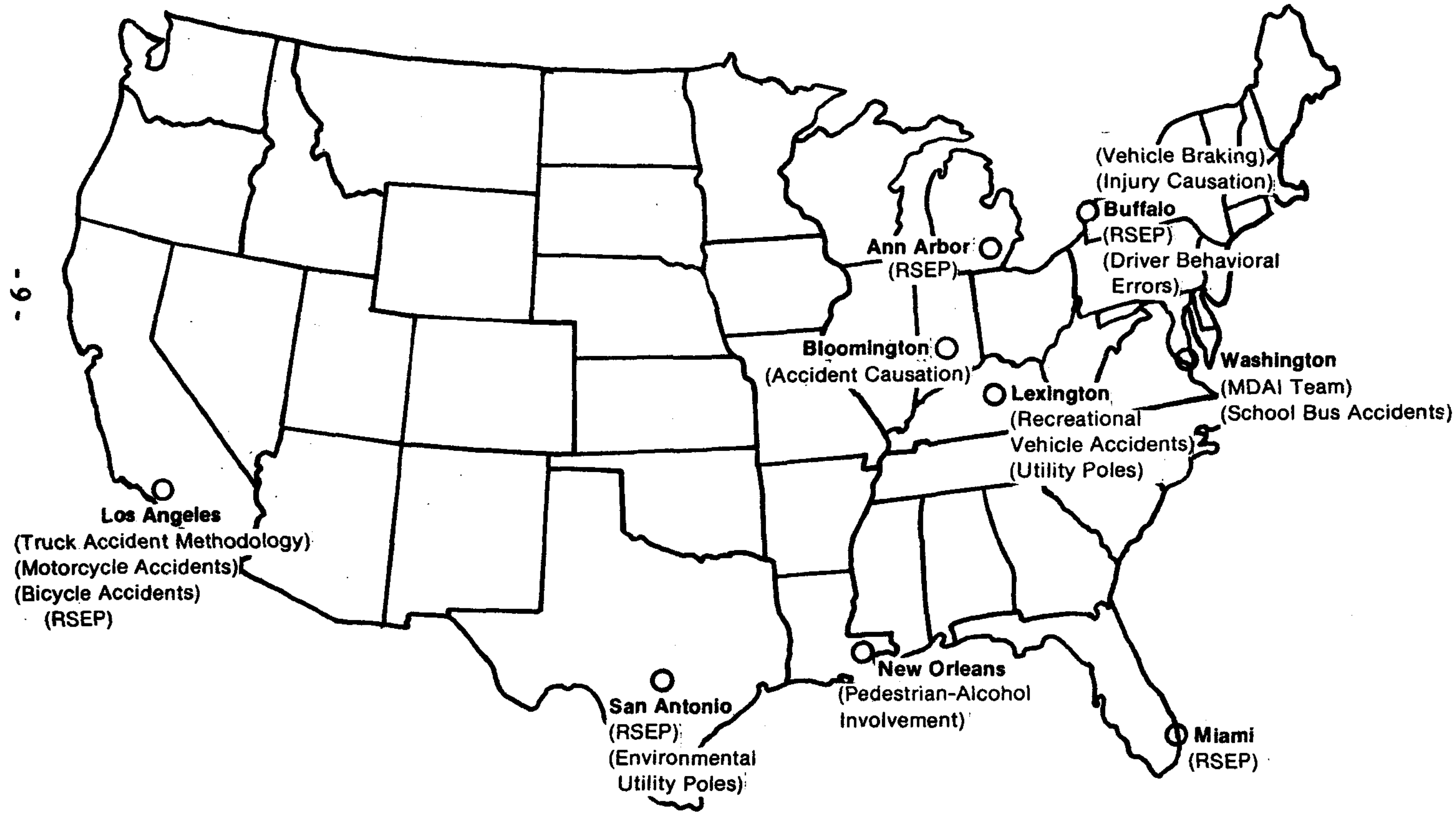
In Figure 1-2, the location of many of the teams currently funded by NHTSA is shown, including the present study of accident causation. Each of these is a "special study," focusing on a particular aspect of the highway traffic safety problem. At its core, each also includes a multidisciplinary accident investigation team composed of medical doctors, engineers, psychologists, and other accident reconstruction specialists who scientifically analyze accidents to determine accident and injury causation and to make recommendations for possible solutions. Increasingly, these studies are developing levels of data which provide for both clinical evaluations of accident and injury causation, as well as statistically significant information on specific priority problems.

Not reflected in Figure 1-2 are several previous NHTSA studies conducted during the first two years of the present study. These include a study of Intersection Accidents in San Francisco, Restraint Usage Comparisons in Salt Lake City, a study of Alcohol-Involved Accidents in Albuquerque, a study of Fatal Accidents in Oklahoma City, a study of Injury and Damages Indices in San Antonio, a Pedestrian-Alcohol Involvement Study in New Orleans, a Single Vehicle Accident study in Miami, and Alcohol Safety Action Project Evaluation teams in Baltimore and Boston.

The present IRPS study has built extensively on the earlier "Vehicle Defects Project," and differs most notably in directing increased attention to the role of human and environmental factors. Additional details concerning the study approach are provided in the methodology overview section (Vol. I, Section 2.0).

Figure 1-2

Multi-level Accident Investigation Studies



RSEP—Restraint System Evaluation Program Regional Team

Fall, 1975

(Reprinted by Courtesy of the National Highway Traffic Safety Administration)

2.0 Methodology Overview

This section provides an overview of the methods and procedures employed in the study, including (1) data collection, (2) clinical case-by-case assessment, and (3) quantitative analysis methods and procedures. More detailed descriptions of analysis procedures accompany many of the substantive sections; the data collection aspects (i.e., accident investigation procedures) are described in greater detail in Interim Report I, Volume II (1).

The study has involved both the on-scene investigation of accidents by teams of technicians (on-site or Level B investigations), and the subsequent in-depth investigation of subsets of these accidents by multidisciplinary teams (in-depth or Level C investigation).

The basic approach has been to acquire as much relevant information as possible regarding each accident's occurrence, and then make clinical case-by-case determinations of the causal factors involved. Factors are placed within a hierarchical structure for which major categories are well defined. Assessments occur with reference to an assessment system, permitting each causal factor to be evaluated as certainly, probably, or possibly involved and as being of either causal or severity-increasing significance. **Each accident may have a number of causes, and by cause is meant a deficiency without which the accident would not have occurred.**

It should be noted that while causal factors are classified as being human, vehicular, or environmental, this in no way requires that the applicable countermeasures for a particular cause must be in the same area. That is, the best countermeasure for a human cause could well be one which involves changes in either the vehicle or the environment, and so forth.

2.1 Data Collection

Data were collected on three levels, as described in the introductory section. **The collection of the baseline information on Level A** involved several types of collection efforts. Recently, comprehensive vehicle registration and driver license data were obtained from the Indiana Bureau of Motor Vehicles, by having them produce a special tape to IRPS' specifications which extracts Monroe County information from all that recorded for the State. The second type of collection required IRPS personnel to visit the local license branch to obtain license and vehicle registration data via a systematic sample of hard copy applications. The third type of collection involved general population surveys. During Phase IV, a sample of general population licensed drivers, stratified by age and sex, was surveyed as to driving knowledge and vision. The latter was tested using a prototype dynamic vision testing device, developed under contract to NHTSA by the Systems Development Corporation. The baseline driving knowledge and vision test data provided for comparisons with the accident population. In addition, by retesting a subset of the general population subjects, the reliability of the vision testing device was assessed.

The Level B or on-site teams were staffed by technicians. These teams at various times were comprised of either one, two, or three individuals. While three individuals provided for an optimal division of workload, with one team member handling human factors, another environmental and a third vehicular, it was found too costly. Instead, it was found desirable to expand the hours of coverage, at the same time decreasing the amount of information required to be collected as a part of each investigation so that only one or two investigators are required. Throughout Phases II and III, and prior to 4 February 1974 in Phase IV, coverage was limited to 10 hours per day, 7 days per week. The 10 hour period, which ran from 11:30 a.m. to 10:30 p.m. with one hour out for meals, took into account the periods of highest accident frequency. However, this alignment was obviously undesirable in terms of observing phenomena which varied as a function of time of day and, for example, IRPS samples underrepresented both nighttime accidents and those resulting from alcohol-impairment. Hence, by realigning the teams as mentioned above and with the support of additional funding from NHTSA, coverage was expanded to 24 hours per day, 7 days per week on 4 February 1974, with the result of more than doubling the accident acquisition rate in Phase V and the latter part of Phase IV. Under this expanded coverage, both one-and two-person teams were employed, and certain data items were identified which need not be acquired other than when two-person teams were in effect. Schedules were adjusted so that two-person teams, in operation approximately 60 to 70 hours per week, covered those periods experiencing the highest accident frequency. Upon receiving notification of an accident by radio monitoring of police frequencies or by a direct hot-line telephone call from police agencies, the IRPS on-site investigation team on duty immediately responded to the accident scene in a special investigation vehicle. At the scene, the team interviewed drivers, inspected involved vehicles and the driving environment, and measured skidmarks and other physical evidence. Later, based on information collected at the scene, the team reached conclusions as to factors which caused the accident. Conclusions and other data generated by the team are then collated and reduced for subsequent analysis.

As a part of each on-site investigation, cooperation of involved parties was sought for subsequent in-depth investigation. The cooperation required was to agree to a subsequent, post-accident interview, and to permit vehicles to be driven or towed to the IRPS garage facility for more detailed inspection. Accidents were acquired for in-depth investigation on a chance basis, without regard to suspected accident causes. However, the refusal of motorists to cooperate prevented a random sampling procedure from being applied. Instead IRPS' approach has been to acquire all possible accidents, and then to subsequently examine the representativeness of the subset obtained (section 9.0). For some variables these have been found to be representative, and numerical adjustments to aggregate measures of human, vehicular and environmental factors have been made to assess the influence of non-representativeness where it occurs in the on-site data.

The subsequent **in-depth (Level C) investigations,** conducted at the recent rate of about 100 per year, involved examination of human, vehicular, and environmental factors by a multidisciplinary team. The subsequent driver interviews were conducted by psychologists or sociologists, and during Phase IV involved both dynamic vision testing and driver knowledge testing. The vehicle inspection was conducted at the IRPS garage facility by one of IRPS' automotive engineers, using an improved version of the inspection guide which was originally developed for the "Vehicle Defects Project." All in-depth investigations have involved inspections of the accident environment by experienced investigators and accident reconstruction personnel, and through the second half of Phase III, all of Phase IV, and early portions of Phase V, a doctorate degree-holding traffic and transportation engineer headed the in-depth team and participated in each of the investigations as a full-time team member. Accident reconstruction personnel assisted in identifying, collecting, and interpreting accident-induced physical evidence, calculating speed estimates whenever possible, and making detailed scale drawings showing the accident scene and the pre-, at-, and post-impact trajectories of involved vehicles. Subsequent to the collection and analysis of information, the multidisciplinary group convened to review the evidence in an Analysis and Conclusions Session, reaching group conclusions as to accident causes. In addition to reducing this data for subsequent automated analysis, a separate case report on each investigation was prepared and submitted to NHTSA.[1]

Accidents investigated included accidents of all severities in about the same proportion in which they actually appeared in the population of reported accidents. Undoubtedly many accidents occur, generally of a minor nature, of which the police are never advised. In that case, unless an IRPS unit happened to observe the accident, it is unlikely that an on-site team would ever become aware or respond, since notification was generally achieved through either a hot-line telephone call from police agencies, or monitoring of police radio frequencies. However, even when police are called and respond to an accident scene, the accident may not be worked if, in the opinion of investigating police officers, no vehicle or other property has been damaged in the amount of $100 or more and there is no personal injury, or if the accident has occurred on private property. If there was any question concerning the accident qualifying for a mandatory police report, IRPS investigators asked investigating officers at the scene whether they intended to regard the accident as calling for an official report to the State. They then based their decision on whether to work the accident on this response. Even given this constraint, approximately 70 to 80% of the accidents within IRPS' on-site sample involved only property damage, which corresponds closely with national figures for reported accidents. However, were it not for the exclusion of very minor accidents, even a higher proportion would involve only property damage. The primary reason for IRPS' exclusion of non-police-investigated accidents was so that the police record is available to substantiate that such an accident occurred, and so that IRPS is not in the position of having the only record available, which would probably result in an undue number of litigation or settlement-related inquiries. **The only other significant exclusion was of accidents involving large trucks (over 8,000 lbs. gvw), and vehicles pulling trailers.** The former were excluded because they could not be handled in the same manner as passenger cars with the tools and garage facilities available to IRPS,[2] and generate unusual complexities of braking and handling, especially where articulated vehicles are concerned. The same reason applied for vehicles pulling trailers, which constitute a very

[1] The requirement for submission of case reports was suspended late in Phase V.

[2] In particular, they could not be accommodated by the Clayton dynamic brake tester in use during early phases of the study.

small percentage of the accident population, and which may present unusual difficulties of accident reconstruction. Motorcycles were included within Phases I, IV, and V of IRPS data, but were excluded during Phases II and III, again because it was thought that insufficient information was available regarding dynamic aspects of motorcycle handling to treat them with the same confidence as passenger cars. Instead, it was thought that separate studies focusing on such vehicles was preferable to a division of effort within the present study. More recently, the need for basic causative information has overridden the concerns about the difficulty of reconstruction. Pedestrian accidents generally have been included, although during Phases IV and V it was decided these would be worked only by the on-site team, and would not be investigated by the in-depth team. This was a minor policy decision reached in conjunction with NHTSA. Of the 205 Phase IV and V in-depth accidents, a representative sample of the pedestrian accident configuration would have consisted of only three accidents.

Conclusions reached by Level B and C teams were tabulated, and **causal factor results were expressed as the percentage of accidents in which they were implicated.** Analyses were then conducted to assess trends in accident causation across phases, the extent of agreement and disagreement between on-site and in-depth teams in the attribution of accident causes, the model year distribution of vehicles having causative vehicular deficiencies, and the relationships between accident causes and both driver and accident characteristics.

2.2 Causation Assignment

Accident causes were determined by the clinical assessments of the Level B (on-site) and Level C (in-depth) investigation teams. These assessments by the two teams occurred independently of each other. The on-site assessment actually occurred prior to, and without knowledge of the in-depth data or conclusions. However, the in-depth team was permitted access to on-site data and opinions, but based their decisions primarily on the information gathered in the in-depth phase. On-site information was used whenever some of the evidence was extremely transitory in nature, or whenever a driver's initial description of the accident differed significantly from his recollections later. **Thus, the on-site data constituted a subset of the total data available to the in-depth team, whose conclusions were independent of the on-site's.**

During the period reported, on-site teams were comprised of either one or two investigators, although during previous phases as many as three persons comprised an individual on-site team. After completing their investigations at the scene and reducing data to the various collection forms, these team members jointly decided which causal factors should be cited. Their discussion occurred with reference to an accident cause dictionary (see "glossary"). Conclusions were then entered on a designated form, coded, keypunched, and stored for later analysis. Procedures were similar for the in-depth team, but were based on more detailed data, and were conducted by professionals within each of the relevant disciplines.

During Phase V, there were six principal members of the in-depth team: a human factors specialist who headed the team (previously a sociologist, at present a psychologist), an automotive engineer (IRPS employs three but only one participates in a given investigation), a reconstruction specialist, a draftsman/environmental data collection aide, and an engineering assistant/technical writer.[3] Following the team's investigation of each accident and reduction of data, a formal analysis and conclusion session was held. To optimize the team's decision process, i.e., reduce individual biases without incurring group pressures towards conformity, the following structure was developed for the A & C session. Each accident was analyzed by only four members: the technical writer chairing the session, the human factors specialist, the automotive engineer and the accident reconstruction specialist. The session was divided into three major functional phases:

1. **Accident description,** presented by each of the three specialists. It includes slides and scaled drawings of the accident scenes with reconstructed vehicle trajectories through the collision sequence, computed speed estimates, and ambient conditions (by the reconstruction specialist); inspection data of all vehicles involved and discussion of potential relevance (by the automotive engineer); and relevant human factors data including biographical background, interviews with the drivers, and results on driver knowledge, vision and reaction time tests (by the human factors specialist).
2. **Causal factors identification.** When all the information has been presented, the members independently identify the causal factors. For this purpose IRPS has developed a glossary of human, vehicular, and environmental factors of potential causal significance (see "glossary"). The causal factors are then shared with the other team members and a common set of causal factors is identified. The writer coordinating the session verbally reviews the data and events relevant to each of the causal factors.
3. **Probability assessment.** An ordinal scale, developed in Phase II, permits the investigators to express their assuredness of the conclusion as certain, probable, or possible (Figure 2-1). A **certain** rating is applied when there is absolutely no doubt as to a factor's role, and is considered analogous to a 95% confidence level. Thus, an assessment that a factor was a "certain cause" of the accident means that, assuming all else remains unchanged, there is no doubt but that if the deficient factor had been removed or corrected, the accident would

Figure 2-1

Causal Factor Rating System

Certainty of Investigator Assessment	Significance of Assessment	
	Causal	Severity-Increasing
Certain		
Probable		
Possible		

[3] A traffic engineer headed the team during Phase IV, the latter part of Phase III, and the early months of Phase V.

not have occurred. This is not to say that there were not other factors present which also played a causal role, meaning that their correction might also have prevented the accident. The **probable** rating means "highly likely although not definite," and is considered analogous to an 80% confidence level. A **possible** rating is used to designate factors which are of potential relevance, although evidence does not substantially support their existence and/or involvement. Analogous confidence figures are considered somewhat tenuous for the "possible" level, but are estimated to represent a confidence of from 20 to 80%. Thus, the failure to tally a factor at the possible level represents the judgment that its involvement was highly unlikely.

A more analytical procedure was developed in Phase V with a dual purpose in mind: (1) to be used in evaluating team members' use of the verbal categories certain, probable and possible, and (2) to improve the assessment methodology for future applications. The procedure requires each of the three voting team members (the writer does not vote) to assign a confidence level ranging from 0.00 to 1.00 to two independent events: (1) the probability of the **existence** (E) of the causal factor [P(E)], and (2) its **involvement** (I)—the conditional probability that had the factor been removed the accident would have been prevented [$P(\overline{acc}|\bar{E})$]. The group average for each of the probability estimates is calculated, and the product of the two is then defined as the derived involvement (DI).

In order to compare the old methodology with the new, in Phase V, after all the accident information had been presented, the team members independently rated the causal factors both in categorical terms (certain, probable, and possible) for an overall assessment (OA), and numerically for determining E and I. Whenever the writer—after averaging the E and I ratings—noted great variance (difference of .4 or more between highest and lowest estimate), the factor was discussed and rated again, this time with the writer's rating included. Before the end of the A & C session, the members once again rated categorically each of the factors (OAR), as certain, probable or possible.

This recent modification to the assessment procedure is discussed in greater detail in Section 7.0.

Under both the original and revised procedures just discussed, factors are designated as being of either **causal or severity-increasing significance,** according to the following definitions:

- **Causal Factor**—a factor necessary or sufficient for the occurrence of the accident; had the factor not been present in the accident sequence, the accident would not have occurred.[4]

[4] The "or sufficient" aspect of this definition was intended for situations where there were multiple sufficient causes (i.e., more than one factor which, by itself, absent any other deficiency or failure, would have caused a particular accident). For example, it is conceivable (however improbable) that a heart attack could coincidentally occur at the same time as a mechanical failure, in a situation where either alone would have led to the same accident. In this instance the "but for" test fails (i.e., neither factor by itself is necessary), but the "or sufficient" aspect would serve to retain both factors as "causes." In practice, it is doubted that circumstances of this kind were encountered, so that the operational definition was one of "necessity." In other words, a factor was considered a cause if "but for" that factor, the accident would not have occurred.

- **Severity-Increasing Factor**—a factor which was neither necessary nor sufficient for the accident's occurrence, but removal of which from the accident sequence would have lessened the speed of the initial impact which resulted.

These definitions describe only pre-crash factors. Crash phase factors such as the performance of seatbelts, and post-crash factors such as the outbreak of fire are not intended to fall within either the "causal" or "severity-increasing" definitions. The following examples are intended to clarify the proper usage of these terms:

Example #1: A driver in heavy traffic suddenly notices that the vehicle ahead of him has stopped, and that he has no reasonable means of avoiding an accident other than staying in his lane and stopping. He hits his brakes and skids into the vehicle in front of him. Investigation reveals that due to a master cylinder problem, only his rear brakes were operative. It is calculated that even the poorest braking efficiency which could have been expected with all four wheels braking properly would have brought his vehicle to a stop several feet short of impact.

Result: The braking system problem would be cited as a *causal factor* (and other factors might be cited if identified).

Example #2: In this instance the situation is the same as above, except it is calculated that even with properly operating brakes, collision would not have been avoided, although the speed of impact would have been reduced.

Result: The brake system problem would be cited as a *severity-increasing* factor rather than as a *causal factor*.

There is no limit to the number of factors of either significance which can be identified for a particular accident. Particularly in the second example, it is likely that there has been a delay or failure on the part of the driver which has placed him or her in a situation where even properly operating brakes would not enable him to stop short of the vehicle in front. A human factor—possibly *inattention*—might also be identified as a *causal factor* in the same accident.

It should also be noted that the countermeasure for a particular kind of problem may be in a different area than the problem. For example, many human causes may imply the need for changes in vehicles or the environment. Remedies for inattention might include radar warning or brake activation systems, improved brake lights, etc.

Sample results from the detailed causal data tables (which appear in Appendices A and B) are shown in Figure 2-2. These illustrate the six main cells generated by the three certainty and two significance definitions just discussed. Note that the addition of a summary *causal or severity-increasing* column results in three additional cells, or a total of nine for each level

Figure 2-2

Example of Detailed Causal Data Tables Found in Appendices A & B[1].

DETAILED HUMAN CAUSATION SUMMARY BY ACCIDENT FOR PHASES II, III, IV AND V

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
II. HUMAN FACTORS	CERTAIN	C	297	70.7	2	.5	299	71.2
		B	1451	64.3	5	.2	1456	64.5
	CERTAIN OR PROBABLE	C	388	92.4	1	.2	389	92.6
		B	2034	90.1	6	.3	2040	90.3
	CERTAIN PROBABLE OR POSSIBLE	C	409	97.4	2	.5	411	97.9
		B	2144	95.0	9	.4	2153	95.3
II. A. DIRECT HUMAN CAUSES	CERTAIN	C	296	70.5	2	.5	298	71.0
		B	1393	61.7	6	.3	1399	62.0
	CERTAIN OR PROBABLE	C	387	92.1	1	.2	388	92.4
		B	1976	87.5	10	.4	1986	88.0
	CERTAIN PROBABLE OR POSSIBLE	C	407	96.9	2	.5	409	97.4
		B	2093	92.7	14	.6	2107	93.3
1.0 CRITICAL NON-PERFORMANCE	CERTAIN	C	7	1.7	0	0.0	7	1.7
		B	25	1.1	0	0.0	25	1.1
	CERTAIN OR PROBABLE	C	9	2.1	0	0.0	9	2.1
		B	30	1.3	1	.0	31	1.4
	CERTAIN PROBABLE OR POSSIBLE	C	11	2.6	0	0.0	11	2.6
		B	32	1.4	1	.0	33	1.5
1.1 BLACKOUT	CERTAIN	C	2	.5	0	0.0	2	.5
		B	13	.6	0	0.0	13	.6
	CERTAIN OR PROBABLE	C	2	.5	0	0.0	2	.5
		B	16	.7	1	.0	17	.8
	CERTAIN PROBABLE OR POSSIBLE	C	2	.5	0	0.0	2	.5
		B	17	.8	1	.0	18	.8

[1] Darkened boxes indicate source of "definite cause" and "probable level" causation data, frequently referred to in the text. Definite cause results are taken from the "causal-certain" cell, while "probable level" results are taken from the "certain or probable, causal or severity-increasing" cells.

(Figure 2-2). Since results for both Levels B and C are shown in this same table, the end result is that for a given causal factor, there are a total of 18 cells of interest (each of which contains information regarding both *n* and *percent of accidents investigated).*

While this method of presentation is well suited to a data user interested in details concerning a particular causal factor, it does not facilitate generalization as to the relative involvement of different factors. For this reason results from only a few of Figure 2-2's cells have been extracted for presentation in summary tables, and for use in many of the sub-analyses. These are:

- the **causal-certain** cell—results from this cell are termed *definite causes,* and
- the **certain or probable-causal or severity-increasing** cell—results from this cell are termed *probable level* results, or results *with probable findings included.*

The *dictionary* of causal factors employed appears in a Glossary at the end of the report, and the assessment methodology is further described in Interim Report I (Volume II, Appendix A) (1). The causal hierarchy used, and many of the factor names had their origin in earlier NHTSA-sponsored research and in an MVMA-sponsored study conducted by Cornell Aeronautical Laboratory (now Calspan, Inc.) (2).

2.3 Limitations and Implications of the Causal Assessment Methodology

The above-described procedures to assess accident causes were selected so as to arrive at a comprehensive accident causation assessment procedure within practical time/cost limitations. In order to obtain a practical significant data set size, the methodology at a certain point had to be "frozen" in order to ensure that all causes were based on the same definitions and all assessments made with the same methodology. With these restrictions in mind, the limitations of the present causal assessment approach are enumerated and discussed below. The limitations of the present approach evolve around three main issues and an implication for accident countermeasures:

- *The Definition of a Cause*

The Indiana definition is based in the test of necessity, although even here this definition is criticized on the grounds that it is hard to conceive of a deficiency which is **always** present in an accident (and hence truly necessary). In other words, there is a conflict in the reconstructionists' notion of necessity (necessary, but only for **this** accident, such that "but for" this factor, this accident would not have occurred), and the logician's sense of necessity (i.e., if it's really necessary to **an accident,** it will be present in each and every accident that occurs). Clearly, in future efforts a high level of attention must be focused on further developing the concept and definition of "accident cause." And, it is anticipated that this will involve focusing not so much upon the philosophical issue of what is a cause, as on what kind of information is most useful in designing a countermeasure.

• *The Case Study Approach*

In the strictest sense, in order to define a cause-and-effect relationship (e.g., "inattention causes accidents"), the independent variable (such as inattention) should be under strict experimental control. Since in a naturalistic accident investigation this is impossible, one of two weaker methodologies must be used. The first is an observational-correlational approach in which a cause is defined as a factor that is associated with an increase in the risk or probability of an accident. Being a pure associative (statistical) definition, the mere over-representation of any human, vehicular, or environmental characteristic would make this characteristic a causal factor. Thus, young drivers and old vehicles would be accident causes.

The approach utilized here—the case study method—actually assesses a cause-and-effect relationship, but the process is both subjective and post-hoc. The causes defined in this way are specific events within a closed-loop model of the driver-roadway-vehicle system, that by virtue of their presence or occurrence caused a failure in the system (i.e., the accident). The major shortcoming of this approach is in the fact that the attribution of a "cause" is a subjective process which, in the present study, is not validated against any external criteria. It is because of this particular weakness that the analysis and causation assessment process needs to be as explicit, systematic, and comprehensive as possible so as to lend it, at the very least, content validity. (See Anastasi, 1961, for a comparison of various validity criteria). Partial concurrent validity could be measured (though this was not done here) through the use of computer simulation of accident reconstruction (one such partial computer simulation is Calspan's SMAC Program). For such an effort to be comprehensive, it would, however, have to include many human information-processing parameters. Other approaches might also be designed.

• *The Post-Hoc Analysis*

In doing a post-hoc accident analysis there are at least two biasing factors. First, one is blessed with the powers of hindsight yet attempts to make a "predictive" evaluation of cause-and-effect. Put in another way, in judging a factor to be "necessary" we state that, given that all else remains the same, the occurrence of a particular failure (e.g., inattention) will cause an accident. It appears, however, that one effect of the post-hoc knowledge (that an accident did in fact happen) is that it imposes a pattern which selectively increases the perceived predictability and avoidability of accidents (Walster, 1966). Recent experimental studies by Fischoff (1974) indicate that having outcome knowledge of a clinical case increases the perceived postdicted likelihood of that particular outcome (regardless of whether it was in fact true or not) and "changed the perceived relevance of event-descriptive data . . . . Judges were, however, largely unaware of the effect that outcome knowledge had on their perceptions. As a result, they overestimated what they would have known without outcome knowledge." The implication of Walster's argument and Fischoff's findings is that if a particular cause was "postdicted" to have caused a certain percent of the accidents, it is not necessarily true that the removal of this factor would eliminate that same percentage of accidents.

Second, in conducting a post-hoc assessment, much of the accident-descriptive data is based on drivers' and eyewitnesses' reports. These are subject not just to a loss in memory over time but also to specific biases in the reconstruction of the accident around these fragments of memory. Although the psychologist responsible for the collection, analysis, and interpretation of the human factors data was cognizant of these factors and while physical evidence, witness statements, and other information were carefully evaluated in trying to reconstruct what happened and why, it is unlikely that all such were overcome. Particular problems include the following:

(1) The rapid occurrence of critical events just prior to the accident: Information quickly going through a driver's short-term memory just prior to the accident may not be processed well enough to be transferred into a more permanent storage (long-term memory), and is especially likely to be masked by the trauma of the accident itself.

(2) In reconstructing the accident, the driver operates under the biases of post-hoc knowledge noted above, and complements true events in memory by inserting additional information that would be both consistent with the recalled events and his self-perception as a driver. The longer the interval between the accident and the report, the greater the bias is likely to be. (For this reason, on-site interviews sometimes provided information not obtained in the in-depth interview.)

(3) Some of the bias in the driver's recollection can be inadvertently caused by the phrasing of the questions by the interviewer, even when the questions do not appear to be leading. Thus, Loftus and Palmer (1973) found that after viewing a movie of a staged collision, viewers who were asked whether they saw "any broken glass" after the cars "smashed into each other" reported "yes" significantly more often than viewers who were asked whether they saw "any broken glass after the cars hit each other." This is despite the fact that there was no broken glass in the accident.

- *The Relationship Between a Cause and a Countermeasure*

As noted above, the practical significance of a causal determination is in the ability to provide a solution that will reduce the probability of occurrence of that cause. However, this does not imply that the countermeasure must operate directly on the cause itself. Thus, if human direct causes are identified in 80-90% of the accidents, effective countermeasures can be developed within vehicular or environmental areas which interact with the human causes. To illustrate, when inattention to (or delayed recognition of) vehicles slowing ahead is identified as a cause, effective countermeasures can be envisioned in the vehicular domain through the design of radar-actuated brakes, improved deceleration signals, etc.

In this context, for purposes of the present study a cause was defined as substandard performance of any component in the driver-roadway-vehicle system. The determination of the standards is somewhat arbitrary and was selected so as to represent the state of affairs that could be expected for an alert, sober driver, employing good defensive driving practices; a vehicle that conformed to present as-manufactured standards and capabilities, and an environment that yields good visibility and clear, dry roads. A cause within any of the above categories therefore implies a substandard level, but not necessarily a countermeasure. Thus, if the baseline (normal) vehicle standard had been assumed to include a four-wheel anti-lock, radar-actuated assisted braking system, there would have been many more vehicular causes listed (under braking system problems). While the data collected allows a countermeasure-oriented analysis of accident causes, the causal tabulations do not by themselves indicate where countermeasure efforts should be concentrated.

2.4 Quantitative Analysis Procedure

Although many of the data processing and analytical procedures were established during the performance of *A Study to Determine the Relationship Between Vehicle Defects and Crashes* (3,4), and the first two years of the present study, procedures were improved during the past year. Data editing was refined, providing a greater degree of automation, thereby decreasing processing time and reducing the probability of errors in the data.

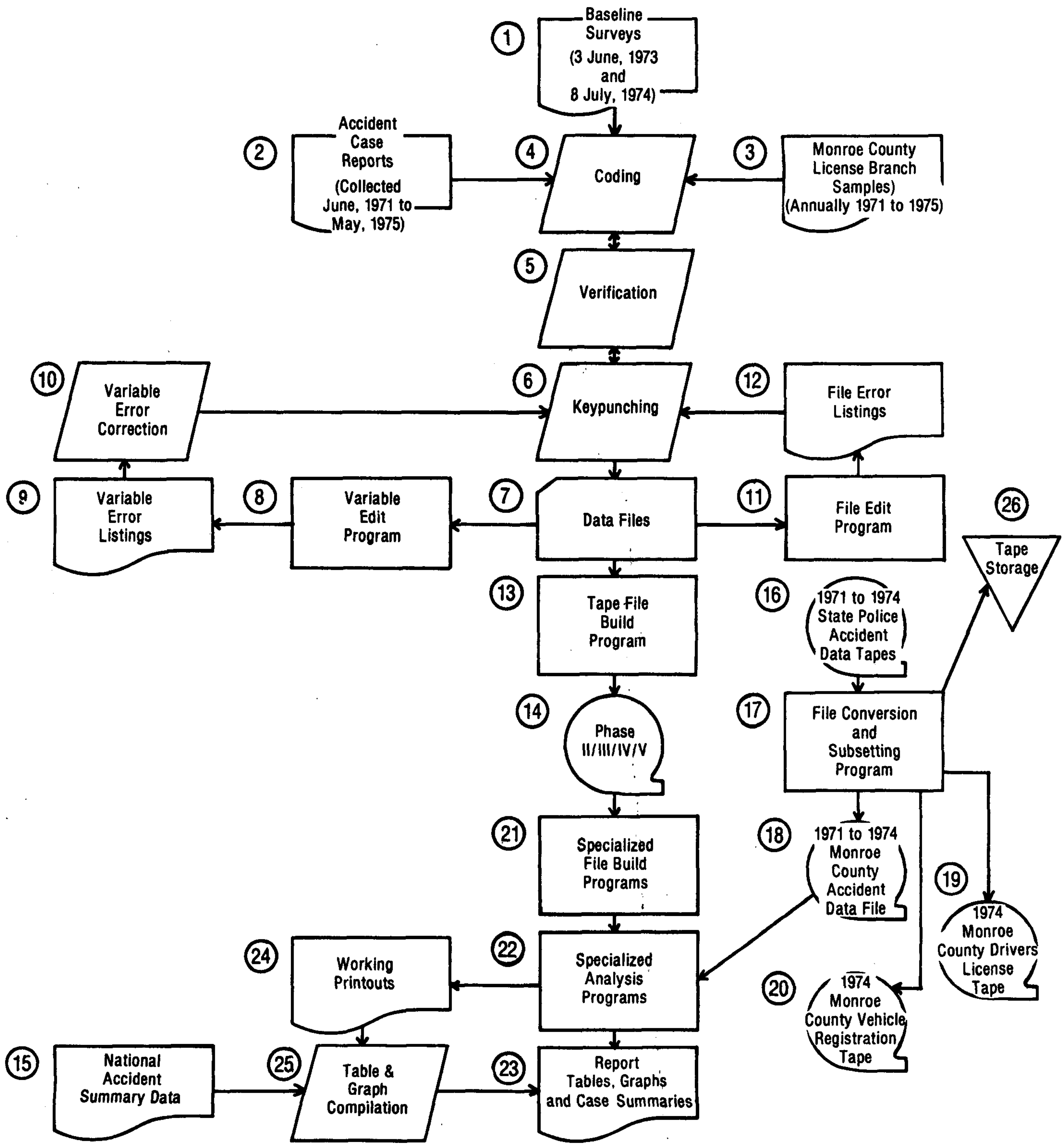
Figure 2-3 is a macroflowchart of the data reduction and analysis process. Circled numbers adjacent to each process, file, or document are used solely as reference aids in the discussion to follow. The chart shows the interfacing of data, process, documents, and files, beginning with accident case report forms (2) and baseline data surveys and samples, (1) (3) and ending with completed report tables and graphs (23) presenting analyses of these data.

Figure 2-3 shows that there were three types of data requiring reduction from hard-copy to machine-readable medium. Baseline survey forms (1) used in the collection of dynamic vision, driver knowledge, reaction time measures and other demographic characteristics of general population drivers were self-coding, and required little preparation for keypunching. Coders (4) merely transferred codes marked by the interviewers to column-numbered spaces of the form. On-site and in-depth data forms from accident case reports (2) were coded separately. Each accident data collection form was identified by case number, level of investigation, traffic unit and occupant number (when applicable), allowing information from separate data collection forms to be merged together by computer after reduction and editing were completed. Other data requiring coding were samples of driver age and sex from registrations on file at the Monroe County License Branch (3). All coding was verified (5) by an alternate coder, in order to reduce the possibility of human error in the coded data. For the baseline survey (1), data items were checked for consistency, and any discrepancies resolved where possible. When inconsistencies could not be resolved by examination of other data items on the form, the discrepant data items were coded as missing. For the accident data (2), the verification process was more extensive. An alternate coder verified each coded case by re-reading the case report, re-examining the codes on the case coding forms, and reconciling any inconsistencies noted. For the drivers license sample (3), data coded onto sampling sheets were verified by a second coder sent to the License Branch.

After coding forms were completed and verified, a keypunch operator punched 80-column

Figure 2-3

Data Reduction and Analysis Procedures



data cards by referring to the code indicated for each card column on the coding form (6) Accident data were punched in batches as coded cases became available. Baseline survey data and baseline sample data were punched en masse. After a number of cards had been punched, decks were subjected to punch-verification (5), where the keypuncher repunched all cards images from the coding sheets into a verifying machine which flagged any card columns potentially in error. Cards having punch errors were corrected on-line. The resultant card decks were then cataloged and stored for editing.

The card decks comprising the preliminary data files (7) were subjected to computer-assisted edits. All card decks were input to editing programs (8) which produced specially formatted listings (9) of the card images which contained variables out of range. Coders reconciled any discrepancies and then took actions necessary to correct the cards in error (10). A final, automated edit check was then conducted on each data array (11). The computer program used for this purpose was specially written to check for proper order of case numbers, traffic unit numbers, and card numbers for each array, and produced a listing (12) of all such cards in error. Using the error listings, coders amended the card deck files, referring to the original accident case reports where appropriate.

The card decks comprising the edited Phase II, III, IV, and V data were written to 7-track magnetic tape (14) by CDC update software (13) which allows controlled read-back of any single data set. This tape served as the primary of four working data files used for all computer-produced and computer-assisted analyses appearing in this report. Police reported accident data, drivers license data and vehicle registration data were obtained from other sources and maintained on separate files. The original source of Monroe County accident data was the state police-supplied tape file containing data on all driver- and police-reported accidents occurring in Indiana during the years 1971 to 1974 (16). Police reported data were converted from 9-track to 7-track for use on Indiana University's Control Data 6600 Computer System. The IRPS-written programs which performed this transformation (17) also subsetted this file to include only accidents occuring in Monroe County, thus producing a 7-track Monroe County Accident Data File (18). Monroe County driver's license (19) and vehicle registration (20) tapes were supplied by the Indiana Bureau of Motor Vehicles and converted from 9-track to a 7-track CDC 6600 compatible format and stored for further use (26). The Monroe County Accident File and Phase II/III/IV/V Analysis File were used as source files for creation of subfiles specially suited to individual analyses performed. For example, production of the causal factor tables presented in Appendices A and B required analysis files having certain subsets of Phases II, III, IV and V causal factor arrays merged on a casewide basis. The array selection, merging, and subsetting operations were performed by file-build programs (21) which produced analysis subfiles properly structured for each analysis to be performed. Report-producing analysis programs themselves (22), written in Fortran IV, directly produced many of the tables (23) appearing in this report. To date, ten programs of this type have been written. These programs allow a user to print causal summary and detailed causal factor results;

compare accident configuration characteristics of on-site and in-depth investigated accidents with all Monroe County police reported accidents; assess pre-crash factor (assessments of accident causes), on-site and in-depth team agreements/disagreements for accidents investigated by both teams; list cases involving user specified causal factors or cases where there were particular types of on-site/in-depth pre-crash factor agreement or disagreement; analyze trends in causal factor identification rates by phase of investigation; produce monthly/quarterly updates of on-site and in-depth identification rates for human, vehicle and environmental causes; and produce case summaries for accidents investigated by the on-site team. While report-producing software were used where feasible, many of the analyses were performed by way of SPSS (Statistical Package for the Social Sciences), OSIRIS (as developed by the Institute for Social Research, University of Michigan) and a special cluster analysis program modified for IRPS use by a member of the Indiana University faculty. For analyses of this type, the programs produced intermediate or working printouts (24) from which staff members compiled tables and drew graphs. These working printouts contained intermediate data such as one-way frequency distributions, cross-tabulations, chi-square statistics, etc. These intermediate figures were used in manual computations and transformations, and then transcribed into tables appearing here. For the Representativeness Analysis (section 9.0), documents showing national accident summary statistics (15) were used in conjunction with working printouts containing frequency distributions on Monroe County accidents to produce some of the tables shown in that section.

3.0 Causal Result Tabulations

3.1 Introduction

This section, based on data extracted from the detailed data tables in the appendices, provides a summary of results indicating the frequency with which the various potential causal factors were implicated in the accidents investigated. Whereas later sections emphasize various analyses performed based on these tabulations, the present section simply summarizes and discusses these tabulations for all accidents examined. The present section would be the best source of such information as the extent to which a particular group of causal factors (e.g., vehicular factors) or specific sub-factor (e.g., bald tires) was determined to be involved as a causal or severity-increasing factor. **These tabulations are "by accident" rather than by individual driver or traffic unit;** that is, they indicate the percentage of accidents in which a particular factor was implicated. Results are presented for both individual phases (Phases II through V), and cumulatively. Phase I results (compiled during a previous project[1]) are not included, since an important aspect of the reporting structure was not compatible with that of later phases.

3.2 Individual Factors and Sub-factors

Overall results of the study are shown in Figure 3-1.

The following data regarding the extent to which individual causal factors and sub-factors were implicated as accident causes in IRPS data collection Phases II through V, have been extracted from the "detailed data tables" which comprise Appendices A and B of this volume.

Table 3-1 summarizes data indicating the extent to which factors were identified as definite causes of accidents. In other words, whereas factors were often identified as being probable or possible causes, this table is limited to tabulating those situations where investigations established beyond doubt that the factors named were causally involved. As such, these data were actually obtained by extracting information from each of the "causal-certain" cells of the detailed data tables. They are provided here in the text for ease of reference and to facilitate comparisons across phases. Note that the causal factor hierarchy is broken down into several additional levels of detail beyond that indicated by these tables, so that the reader interested in a highly detailed breakdown under a particular factor may need to consult the detailed data tables of Appendices A and B.

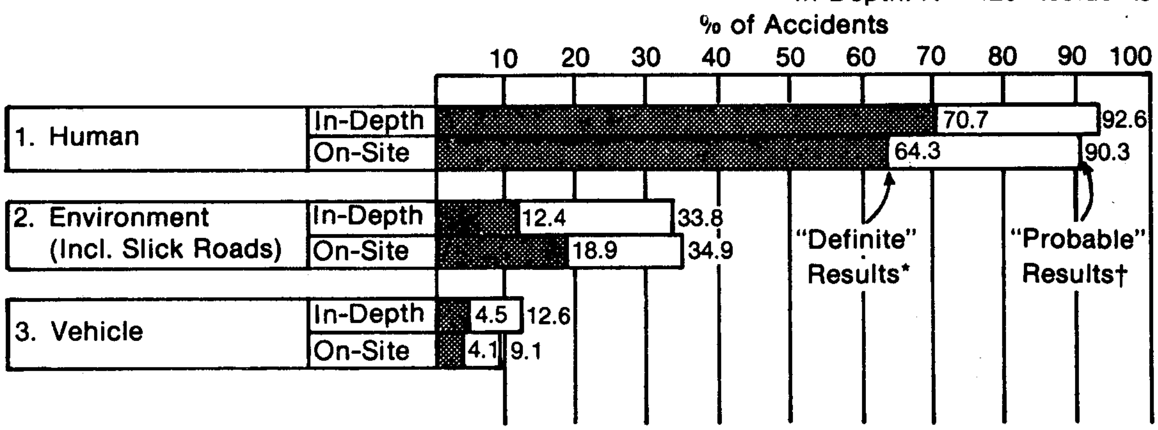
Table 3-2 is similar to 3-1, except that it indicates the proportion of accidents in which factors were at least **probable causes.** It thus includes all accidents in which a factor was tabulated as a definite cause, but includes additional accidents where the same factor was evaluated as being a probable causal or severity-increasing factor. In every case, the probable cause figures for a particular factor should equal or exceed those listed in the definite cause

[1] A Study to Determine the Relationship Between Vehicle Defects and Crashes, conducted by the Institute for Research in Public Safety under Contract No. DOT-HS-034-2-263, for the U.S. Dept. of Transportation.

Figure 3-1

Percentage of Combined Phase II, III, IV, & V Accidents Caused by Human, Vehicular, and Environmental Factors

On-Site: N = 2258 Accidents
In-Depth: N = 420 Accidents



* Definite Means "Causal-Certain" (see Section 2.2 for further explanation)
† Probable Means "Causal or Severity-Increasing, Certain or Probable"

tables. These tables were compiled by extracting the information from the "certain or probable, causal or severity-increasing" cells of the detailed data tables (Appendices A and B). Note that information regarding **possible causes** may also be obtained from the detailed data tables, although summary tables for these data were not prepared.

In Figure 3-1 and those which follow, the data from Tables 3-1 and 3-2 are presented in a graphic format which facilitates a visual comparison between the investigation levels (on-site and in-depth), and permits a ranking of the factors to indicate their relative impor' ınce. **In each of these graphs, factors have been ranked according to the "probable results" from the in-depth level.** The ranking from top to bottom, is in the order of decreasing involvement (as measured at the probable level).

3.2.1 Overall Human, Environmental and Vehicular Results

It may be seen from Figure 3-1 that *human factors* were more frequently involved as accident causes than either environmental or vehicular factors, which ranked second and third, respectively. In the cumulative phase II/III/IV/V results, **human factors were identified by the in-depth team as "definite causes" of 70.7% of accidents, and of 64.3% by the on-site team. At the "probable level," these figures become 92.6% (in-depth) and 90.3% (on-site).** Thus, conservatively stated, the study indicates human errors and deficiencies were a cause in at least 64% of accidents, and were probably causes in about 90-93% of accidents investigated. In the

Table 3-1

Summary of Percentage of Accidents in Which Different Factors Were Definite Causes[1]

Certainty Level: Definite

	Phase II		Phase III		Phase IV		Phase V		Phases II, III, IV, & V	
	B	C	B	C	B	C	B	C	B	C
Human Factors—Direct Causes	73.0%	84.1%	81.7%	81.0%	66.5%	64.1%	48.3%	51.0%	61.7%	70.5%
1. Critical Non-Performance	.9	1.3	1.0	0	1.7	2.9	.8	2.0	1.1	1.7
a. Blackout	.8	.7	1.0	0	.6	0	.2	1.0	.6	.5
b. Dozing	.2	.7	0	0	1.1	2.9	.6	1.0	.5	1.2
2. Non-Accident (e.g., Suicide)	0	0	0	0	0	0	0	0	0	0
3. Recognition Errors	36.0	47.7	47.4	49.2	36.5	36.9	24.7	31.4	33.3	41.4
a. Driver Failed to Observe Stop Sign	4.3	9.9	2.9	3.2	3.0	3.9	3.7	4.9	3.6	6.2
b. Delays in Recognition—Reasons Identified	31.3	38.4	42.2	46.0	31.6	34.0	20.0	25.5	28.5	35.2
(1) Inattention	13.2	11.9	13.1	14.3	7.8	7.8	4.3	4.9	8.4	9.8
(2) Internal Distraction	3.4	5.3	3.3	7.9	6.0	6.8	3.6	3.9	4.0	5.7
(3) External Distraction	2.6	1.3	6.2	3.2	4.5	4.9	3.2	4.9	3.8	3.3
(4) Improper Lookout	13.4	21.9	21.6	22.2	13.8	14.6	9.1	12.7	13.0	17.6
c. Delays in Perception for Other or Unknown Reasons	2.1	6.0	5.6	1.6	3.2	2.9	1.9	3.9	2.7	4.3
d. Delays in Comprehension or Reaction—Other or Unknown	.8	1.3	.7	0	0	0	.1	0	.3	.5

Definite Cause Table

Table 3-1 continued

Certainty Level: Definite

	Phase II		Phase III		Phase IV		Phase V		Phases II, III, IV, & V	
	B	C	B	C	B	C	B	C	B	C
4. Decision Errors	40.6	39.1	43.1	28.6	29.1	23.3	19.2	15.7	29.9	28.6
a. Misjudgment	1.7	2.0	2.6	1.6	2.1	1.9	.8	2.9	1.6	2.1
b. False Assumption	√13.8	4.6	7.5	7.9	7.9	5.8	6.2	1.0	8.4	4.5
c. Improper Maneuver	7.2	8.6	7.5	3.2	5.7	1.9	5.0	2.9	6.1	5.0
d. Improper Driving Technique	4.2	7.9	6.2	0	1.1	7.8	.9	2.9	2.4	6.0
e. Driving Technique was Inadequately Defensive	2.1	2.6	3.9	6.3	3.6	1.9	1.2	1.0	2.3	2.4
f. Excessive Speed	8.7	9.3	√13.7	√11.1	7.2	5.8	3.9	5.9	7.1	7.9
g. Tailgating	1.7	.7	1.0	0	0	0	0	0	.5	.2
h. Inadequate Signal	.6	.7	1.3	1.6	1.1	0	.2	0	.7	.5
i. Failure to Turn on Headlights	.4	0	0	0	0	0	0	0	.1	0
j. Excessive Acceleration	.2	0	1.0	1.6	.2	0	.3	0	.4	.2
k. Pedestrian Ran into Traffic	.4	2.0	.7	0	0	0	0	0	.2	.5
l. Improper Evasive Action	7.5	√11.9	5.9	1.6	4.2	0	2.3	1.0	4.5	4.8
5. Performance Errors	3.0	7.9	3.3	7.9	7.2	4.9	6.6	4.9	5.8	6.9
a. Overcompensation	1.5	4.0	2.3	6.3	2.5	1.0	1.5	2.9	1.8	3.3
b. Panic or Freezing	.9	0	0	0	.8	0	.4	0	.6	0
c. Inadequate Directional Control	1.1	5.3	1.0	1.6	3.6	3.9	4.7	1.0	3.0	3.3
Human—Conditions & States										
Physical/Physiological	4.0	3.3	3.9	0	2.1	0	3.2	1.0	3.3	1.4

Table 3-1 continued

Certainty Level: Definite

	Phase II		Phase III		Phase IV		Phase V		Phases II, III, IV, & V	
	B	C	B	C	B	C	B	C	B	C
1. Alcohol Impairment	3.4	1.3	2.9	0	1.9	0	3.1	0	2.9	.5
2. Other Drug Impairment	.2	1.3	.7	0	.2	0	.1	0	.2	.5
3. Fatigue	0	0	0	0	0	0	0	1.0	0	.2
4. Physical Handicap	0	0	.3	0	0	0	0	0	0	0
5. Reduced Vision	.1	.1	0	0	0	0	0	0	0	.2
6. Chronic Illness	.1	0	0	0	0	0	0	0	0	0
Mental/Emotional	.8	1.3	1.6	3.2	.8	0	.2	0	.7	1.0
1. Emotionally Upset	.4	.7	1.0	0	.4	0	.1	0	.4	.2
2. Pressure from Other Drivers	.2	0	0	1.6	.2	0	0	0	.1	.2
3. "In-Hurry"	.2	.7	.7	1.6	.2	0	.2	0	.3	.5
4. Mental Deficiency	0	0	0	0	0	0	0	0	0	0
Experience/Exposure	3.2	1.3	2.9	0	.9	0	.6	0	1.6	.5
1. Driver Inexperience	.8	.7	0	0	0	0	.1	0	.2	.2
2. Vehicle Unfamiliarity	.4	.7	.3	0	0	0	.1	0	.2	.2
3. Road Over-Familiarity	0	0	.3	0	.6	0	0	0	.2	0
4. Road/Area Unfamiliarity	2.1	0	2.3	0	.4	0	.3	0	1.0	0
Environmental Factors										
Environmental Factors—Excluding Slick Roads	22.1	17.9	25.5	12.7	21.2	9.7	9.5	4.9	13.2	9.0
1. Slick Roads	7.0	4.0	5.6	6.3	9.1	2.9	4.4	2.9	6.2	3.8

Definite Cause Table

Table 3-1 continued

Certainty Level: Definite

	Phase II		Phase III		Phase IV		Phase V		Phases II, III, IV, & V	
	B	C	B	C	B	C	B	C	B	C
Environmental Factors—Including Slick Roads	16.0	14.6	20.3	7.9	12.5	6.8	13.4	7.8	18.9	12.4
1. Highway-Related	13.0	11.9	13.7	7.9	8.5	4.9	6.5	2.9	9.5	7.1
a. Control Hindrances	2.1	2.6	2.3	0	.9	0	.7	1.0	1.3	1.2
b. Inadequate Signs and Signals	1.9	2.0	2.9	1.6	.8	0	.6	0	1.2	1.0
c. View Obstructions	7.2	5.3	7.5	6.3	6.2	2.9	4.1	1.0	5.8	3.8
d. Design Problems	2.1	3.3	2.6	0	.6	1.9	1.0	1.0	1.4	1.9
e. Maintenance Problems	.2	0	0	0	.2	0	0	.1	.1	0
2. Ambience-Related	3.6	2.6	7.8	3.2	4.9	1.9	3.2	2.0	4.3	2.4
a. Special Hazards	2.5	2.0	6.9	3.2	3.6	1.9	2.6	1.0	3.4	1.9
b. Ambient Vision Limitations	.6	.7	.7	0	.6	0	.3	1.0	.5	.5
c. Avoidance Obstructions	.4	0	0	0	.8	0	.2	0	.4	0
d. Rapid Weather Change	0	0	0	0	0	0	.1	0	0	0
e. Camouflage Effect	0	0	.3	0	0	0	0	0	0	0
f. Environmental Overload	0	0	0	0	0	0	0	0	0	0
Vehicular Factors	7.0	6.0	3.6	0	4.7	3.9	2.2	5.9	4.1	4.5
1. Tires and Wheels	1.3	0	.3	0	.4	1.0	.2	1.0	.5	.5
2. Brake System	2.5	4.0	2.0	0	2.3	1.9	1.0	3.9	1.8	2.9
3. Steering System	.2	.1	.3	0	0	0	.1	0	.1	.2
4. Suspension Problems	0	0	0	0	.2	0	0	0	0	0

Definite Cause Table

Table 3-1 continued

Certainty Level: Definite

	Phase II		Phase III		Phase IV		Phase V		Phases II, III, IV, & V	
	B	C	B	C	B	C	B	C	B	C
5. Power Train & Exhaust	.4	0	0	0	.2	1.0	0	0	.1	.2
6. Communication Systems	1.3	0	.7	0	1.3	0	.7	1.0	1.0	.2
7. Driver Seating & Controls	.2	0	0	0	.2	0	.1	0	.1	0
8. Body and Doors	1.3	1.3	.3	0	0	0	0	0	.1	.5
9. Other Vehicle Problems	(4)	(4)	(4)	(4)	.2	0	.1	0	.4	0

[1]Definite cause means "Causal-Certain." See Section 2.2 for additional explanation.

Notes: (1) Numbers which are encircled (e.g., 9.9) exceed 5%.
(2) One check-mark highlights factors implicated in 10.0%-19.9% of accidents.
(3) Two check-marks highlight factors implicated in 20% or more of accidents.
(4) Results were included with "Body & Doors" in Phases II & III.
These are definite results; probable results appear in the following table (Table 3-2). Results from the possible level appear only in the appendices (Detailed Data Tables).

Definite Cause Table

Table 3-2

Summary of Percentage of Accidents in Which Different Factors Were Certain or Probable Causes[1]

Certainty Level: Probable

	Phase II		Phase III		Phase IV		Phase V		Phases II, III, IV, & V	
	B	C	B	C	B	C	B	C	B	C
Human Factors—Direct Causes	90.6%	96.7%	93.8%	96.8%	89.8%	91.3%	86.2%	84.3%	88.0%	92.4%
1. Critical Non-Performance	1.1	1.3	1.0	0	1.9	2.9	1.2	3.9	1.4	2.1
a. Blackout	.9	.7	1.0	0	.6	0	.6	1.0	.8	.5
b. Dozing	.2	.7	0	0	1.3	2.9	.7	2.9	.6	1.7
2. Non-Accident (e.g., suicide)	0	0	0	0	0	0	0	0	0	0
3. Recognition Errors	50.6	60.9	56.5	55.6	51.6	57.3	48.0	48.0	50.9	56.0
a. Driver Failed to Observe Stop Sign	5.3	9.9	3.6	3.2	3.8	5.8	4.5	4.9	4.4	6.7
b. Delays in Recognition—Reasons Identified	45.1	51.0	51.3	52.4	44.6	52.4	38.7	37.3	43.5	47.9
(1) Inattention	√ 20.6	19.2	18.3	19.0	12.3	12.6	9.2	8.8	13.9	15.0
(2) Internal Distraction	5.3	7.3	4.9	11.1	7.6	12.6	6.0	6.9	6.1	9.0
(3) External Distraction	2.8	2.6	7.2	4.8	6.0	5.8	5.0	4.9	5.1	4.3
(4) Improper Lookout	19.2	√ 25.8	√ 24.5	√ 23.8	√ 20.2	√ 24.3	19.1	18.6	√ 20.3	√ 23.1
c. Delays in Perception for Other or Unknown Reasons	3.2	9.9	5.9	1.6	4.7	2.9	6.4	10.8	5.2	7.4
d. Delays in Comprehension or Reaction—Other or Unknown	1.9	1.3	1.3	0	.6	0	1.1	0	1.2	.5

Probable Cause Table

Table 3-2 continued

Certainty Level: Probable

	Phase II		Phase III		Phase IV		Phase V		Phases II, III, IV, & V	
	B	C	B	C	B	C	B	C	B	C
4. Decision Errors	55.7	60.9	53.6	52.4	45.6	47.6	40.6	40.2	47.3	52.1
a. Misjudgment	2.1	2.6	3.3	4.8	2.8	4.9	2.3	5.9	2.5	4.3
b. False Assumption	17.4	8.6	9.8	14.3	10.4	10.7	10.4	2.0	11.8	8.3
c. Improper Maneuver	7.9	11.3	8.2	3.2	6.2	3.9	6.6	2.9	7.1	6.2
d. Improper Driving Technique	5.8	12.6	8.2	1.6	1.9	10.7	2.5	5.9	3.9	9.0
e. Driving Technique was Inadequately Defensive	2.5	9.3	6.5	15.9	6.6	7.8	4.7	4.9	4.9	8.8
f. Excessive Speed	15.8 √	21.2	17.3	15.9	15.3	13.6	12.6	13.7	14.7	16.9
g. Tailgating	3.0	2.6	1.6	0	.4	1.0	.3	0	1.2	1.2
h. Inadequate Signal	1.9	2.6	2.3	6.3	1.5	2.9	.4	1.0	1.3	2.9
i. Failure to Turn on Headlights	.4	.7	0	0	0	0	.1	0	.1	.2
j. Excessive Acceleration	.4	0	1.0	1.6	.2	0	.7	2.0	.5	.7
k. Pedestrian Ran Into Traffic	.6	2.0	1.0	0	0	0	0	0	.3	.7
l. Improper Evasive Action	15.5 √	22.5	11.4	7.9	9.5	7.8	7.3	8.8	10.3	13.3
5. Performance Errors	5.5	10.6	5.6	12.7	10.8	7.8	10.6	11.8	9.2	11.2
a. Overcompensation	2.3	4.6	3.3	11.1	4.5	1.9	3.0	8.8	3.2	6.0
b. Panic or Freezing	2.6	0	1.0	1.6	1.5	0	1.2	0	1.6	.2
c. Inadequate Directional Control	1.3	7.3	1.3	3.2	4.7	3.9	6.7	2.0	4.1	4.5
Human Conditions & States										
Physical/Physiological	7.5	7.3	7.5	6.3	5.3	7.8	7.9	3.9	7.2	6.7

Table 3-2 continued

Certainty Level: Probable

	Phase II		Phase III		Phase IV		Phase V		Phases II, III, IV, & V	
	B	C	B	C	B	C	B	C	B	C
1. Alcohol-Impairment	5.5	2.6	5.2	6.3	4.9	3.9	7.3	1.0	6.1	3.1
2. Other Drug Impairment	.8	3.3	1.3	0	.2	2.9	.4	0	.6	2.1
3. Fatigue	.6	.7	.3	0	0	3.9	.3	2.0	.3	1.7
4. Physical Handicap	0	0	.3	0	0	0	0	0	0	0
5. Reduced Vision	.6	.7	0	0	.2	0	.1	1.0	.2	.5
6. Chronic Illness	.2	0	.3	0	0	0	0	0	.1	0
Mental/Emotional	2.1	4.6	3.6	3.2	.8	1.9	1.7	1.0	1.8	2.9
1. Emotionally Upset	.6	2.6	1.0	0	.4	1.0	.9	0	.7	1.2
2. Pressure from Other Drivers	.2	1.3	.7	1.6	.2	0	0	0	.2	.7
3. "In-Hurry"	1.3	.7	2.0	1.6	.2	1.9	1.0	1.0	1.0	1.2
4. Mental Deficiencies	0	0	0	0	0	0	0	0	0	0
Experience/Exposure	9.2	1.3	5.9	4.8	1.7	4.9	2.7	2.0	4.5	2.9
1. Driver Inexperience	3.4	.7	1.3	1.6	.2	2.9	1.0	1.0	1.4	1.4
2. Vehicle Unfamiliarity	1.3	.7	.3	4.8	.4	0	.6	0	.7	1.0
3. Road Over-Familiarity	.2	0	.7	0	.6	0	.1	0	.4	0
4. Road/Area Unfamiliarity	4.5	0	3.6	0	.6	1.9	1.1	1.0	2.1	.7
Environmental Factors										
Environmental Factors-- Including Slick Roads	41.7	33.8	41.5	31.7	33.1	39.8	29.3	30.4	34.9	33.8
1. Slick Roads	16.2	7.3	13.7	11.1	14.9	11.7	12.2	9.8	14.1	9.8

Probable Cause Table

Table 3-2 continued

Certainty Level: Probable

	Phase II		Phase III		Phase IV		Phase V		Phases II, III, IV, & V	
	B	C	B	C	B	C	B	C	B	C
Environmental Factors— Excluding Slick Roads	29.6	27.2	31.4	23.8	20.8	31.1	19.7	22.5	23.9	26.2
1. Highway-Related	24.0	21.9	22.5	22.2	14.4	22.3	14.0	18.6	17.6	21.0
a. Control Hindrances	4.5	4.6	3.6	1.6	1.9	1.9	1.8	5.9	2.7	3.8
b. Inadequate Signs & Signals	4.3	3.3	5.9	6.3	1.7	1.0	2.1	2.0	3.1	2.9
c. View Obstructions	13.0	11.3	12.7	12.7	10.2	15.5	9.6	9.8	11.0	12.1
d. Design Problems	4.3	6.0	4.2	3.2	.6	6.8	1.3	2.0	2.3	4.8
e. Maintenance Problems	.8	0	.7	0	.2	0	.1	1.0	.4	.2
2. Ambience-Related	6.6	6.0	10.1	6.3	8.5	9.7	6.6	5.9	7.6	6.9
a. Special Hazards	4.3	3.3	8.2	6.3	5.5	7.8	5.1	4.9	5.4	5.2
b. Ambient Vision Limitations	1.3	.7	1.6	0	1.1	1.0	.9	1.0	1.2	.7
c. Avoidance Obstructions	.8	.7	.3	0	2.1	1.9	.3	0	.8	.7
d. Rapid Weather Change	0	0	0	0	0	0	.1	0	0	0
e. Camouflage Effect	0	.7	.3	0	0	0	.2	0	.1	0
f. Environmental Overload	0	0	0	0	0	0	.1	0	0	0
Vehicular Factors	14.0	17.9	9.2	3.2	10.2	10.7	5.7	12.7	9.1	12.6
1. Tires and Wheels	4.3	5.3	2.6	1.6	1.7	2.9	1.2	4.9	2.3	4.0
2. Brake System	3.0	7.9	2.9	1.6	4.2	5.8	1.9	3.9	2.8	5.2
3. Steering System	1.7	2.0	2.0	1.6	.9	0	.6	0	1.1	1.0
4. Suspension Problems	.4	0	0	0	.6	0	0	1.0	.2	.2

Probable Cause Table

Table 3-2 continued

Certainty Level: Probable

	Phase II		Phase III		Phase IV		Phase V		Phases II, III, IV, & V	
	B	C	B	C	B	C	B	C	B	C
5. Power Train & Exhaust	.6	0	.3	0	.4	1.0	.2	0	.4	.2
6. Communication System	2.8	2.0	1.6	0	2.6	1.9	1.7	2.0	2.2	1.7
7. Driver Seating & Controls	.2	0	0	0	.2	0	.1	1.0	.1	.2
8. Body and Doors	2.1	2.0	.3	0	0	0	0	0	.1	.7
9. Other Vehicular Problems	(3)	(3)	(3)	(3)	.4	0	.2	0	.6	0

[1]Probable Cause means "Causal or Severity-Increasing, Certain or Probable." See Section 2.2 for additional explanation.

Note: (1) Numbers which are encircled (e.g., (20.6)) exceed 10%.
(2) A check-mark (√) highlights results of 20% or more.
(3) Only specific subcategories are highlighted in this manner.

Probable Cause Table

detailed data tables (Appendices A & B), results from a third and more speculative level, designated the "possible cause" level, may be obtained. These results, based on the "certain, probable, or possible—causal or severity-increasing" cell, indicate that human factors were possibly a cause in up to 97.9% of accidents investigated by the in-depth team, and 95.3% on-site (Appendix A, page A-1). Thus, the in-depth team was confident that drivers were totally *non*-responsible in only about 2% of accidents, and the on-site teams were similarly confident in only about 5% of accidents.

Environmental factors of all kinds, including slick roads, are shown by Figure 3-1 to have been **definite causes in 12.4% of accidents investigated by the in-depth team, and 18.9% of those investigated by on-site teams.** Considering probable results, these figures become 33.8 and 34.9, respectively. "Possible" results were 46.0% in-depth and 44.2% on-site, indicating that environmental factors were possibly involved as causes in up to nearly one-half of accidents investigated (Appendix A, Page A-32).

As shown by Figure 3-1, **vehicular factors were identified as definite causes of 4.5% of accidents by the in-depth team, and of 4.1% by the on-site team.** Probable level results were 12.6% and 9.1%, respectively. Possible level results from the detailed data tables indicate that vehicular factors may have been causes in up to 25.2% of accidents in-depth and 14.7% on-site. Thus, both in-depth and on-site results are fairly consistent in indicating that vehicular failures and degradations can be stated with certainty to have caused at least 4 to 5% of accidents, and may possibly have played a causal role in up to 15-25% of accidents investigated.

These results may be examined as a ratio of one type of factor to another, although this is made difficult by the fact that the ratios vary depending on the certainty level examined. **If the definite cause results are used, in-depth team results show human factors being identified as causes about 16 times more often than vehicular factors, and 6 times more often than environmental factors.** If probable level findings are used, in-depth results indicate that human factors were identified as probable causes in about 7 times more accidents than vehicular factors, and a little less than 3 times more accidents than environmental factors.

3.2.2 Human Factors—Direct Causes

Figure 3-2 shows the rank of the human factor categories immediately below the overall human direct cause category in the causal hierarchy. Based on probable cause results, recognition and decision errors were identified with nearly the same frequency, according to both on-site and in-depth results.[2] However, based on definite cause results, the in-depth team identified recognition errors somewhat more frequently than decision errors (41.4% vs. 28.6%). Performance errors ranked third, with probable level results of 11.2% (in-depth) and 9.2% (on-site). Critical non-performances ranked fourth with probable level results of 2.1% in-depth and 1.4% on-site. Ranking last of these five categories was the non-accident (e.g.,

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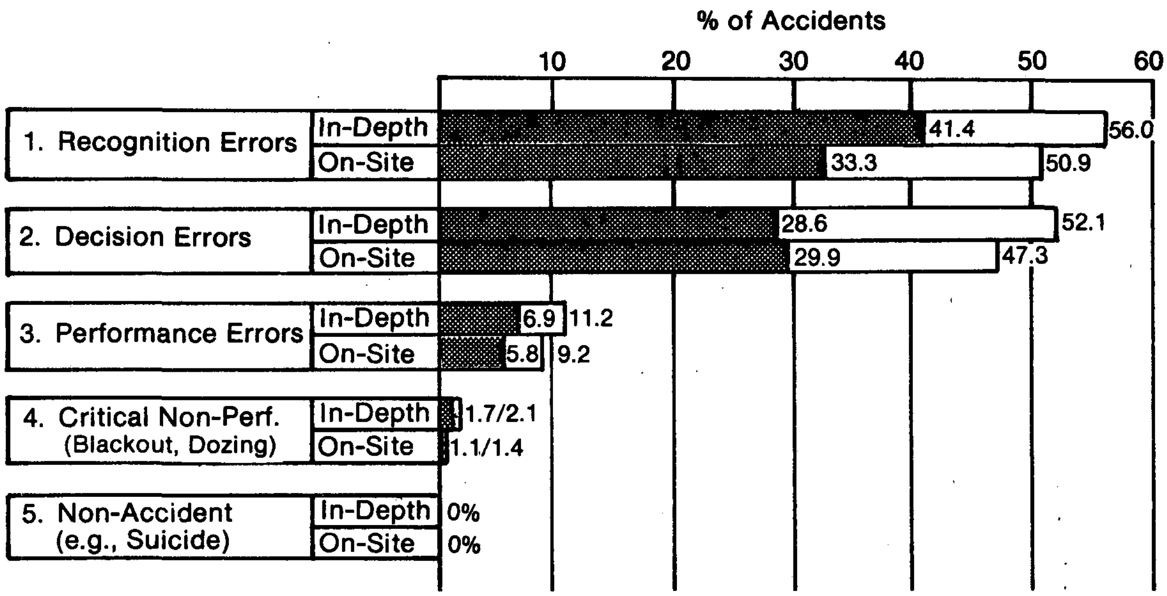
[2] Probable level results: Recognition Errors 56.0% in-depth, 50.9% on-site; Decision Errors 52.1% in-depth, 47.3% on-site.

Figure 3-2

Percentage of Combined Phase II, III, IV, & V Accidents Caused by the Major Human Direct Cause Groups



suicide) category, for which no entries were tallied at the definite, probable, or possible cause levels.

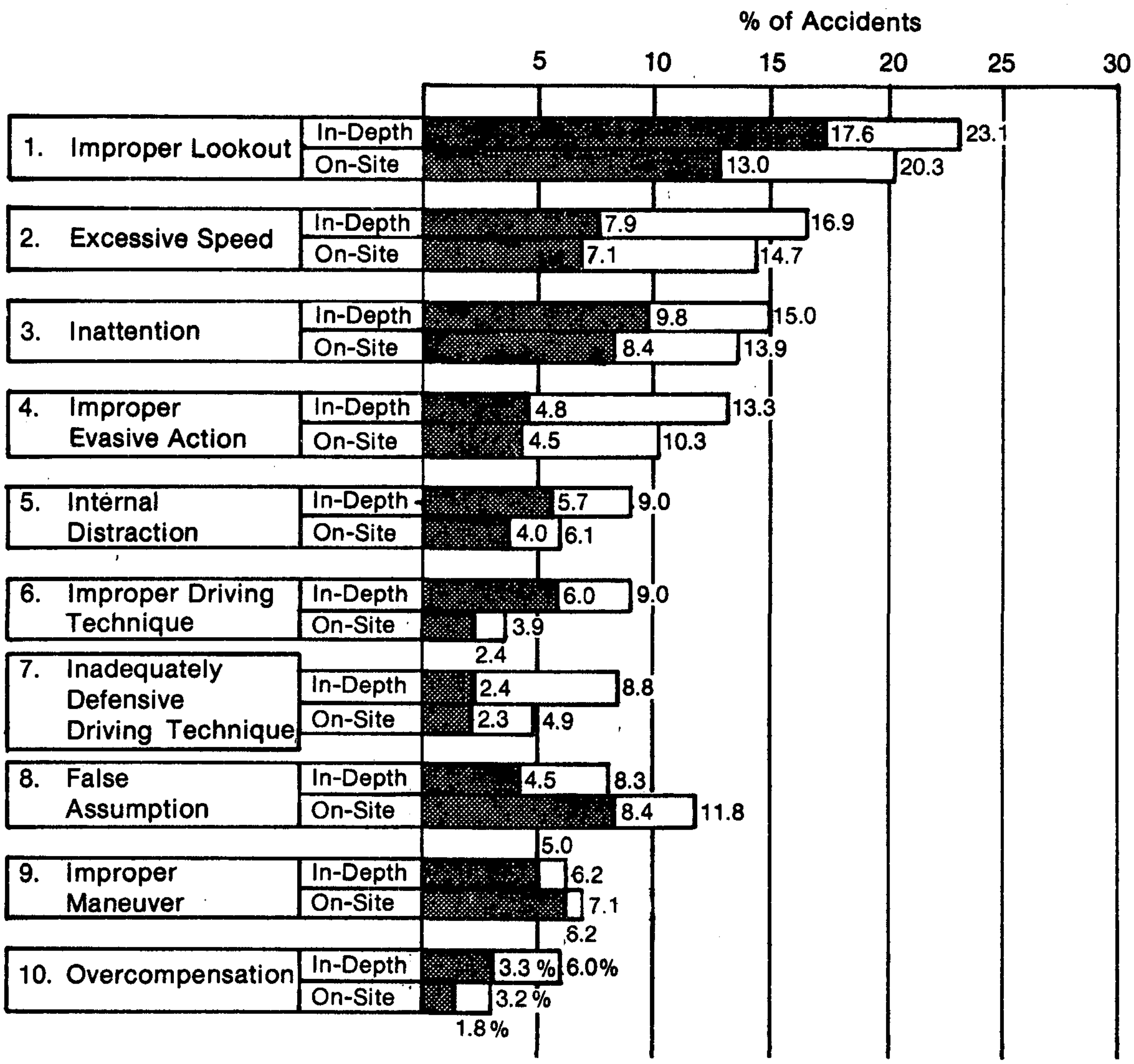
It may be summarized that the human errors and deficiencies which caused accidents primarily involved recognition errors (intended to include both perception and comprehension problems), and decision errors. Less frequently involved but still an important problem were instances where drivers had difficulty in executing actions which they correctly decided were appropriate (performance errors). Only a small portion (less than 3%) of the accidents investigated involved critical non-performances, such as the driver falling asleep or blacking out. Finally, there were no accidents among the 2,258 investigated (Phases II-V) which were identified as being intentionally caused, such as might result from anger or a suicide attempt.

Under the current system for summarizing these causal result tabulations, specific factors from a lower-level in the hierarchy (e.g., inattention and excessive speed) are stipulated to fall within one of these more general headings. Thus, "inattention" is stipulated to fall within the recognition errors category, and is always tallied as a recognition error, even if it sometimes appears to result from poor decision making. Similarly, excessive speed is stipulated as falling under the decision errors category, even though in some cases it may be indicated that a perception or comprehension problem accounted for a driver's excess in speed. Thus, results for recognition, decision, and performance errors must be evaluated by making reference to the specific categories which they contain.

Figure 3-3 presents human direct cause factors from yet a lower level in the causal

Figure 3-3

Percentage of Combined Phase II, III, IV, & V Accidents Caused by Specific Human Direct Causes



hierarchy. These factors, which appear in the hierarchy under the recognition, decision, and performance error headings, have been put in a common pool and then ranked, without regard to their original (higher) classifications. It can be seen that improper lookout is the most frequent accident cause according to both the on-site and in-depth levels. Definite cause results for the improper lookout category were 13.0/17.6% (B/C). At the probable level, results were 20.3/23.1% (B/C). Since there was no other specific factor, either human, vehicular, or environmental which was identified as a cause in as many accidents as this factor, it may be summarized that **improper lookout is the most frequent cause of accidents identified by this study.** The detailed data tables show that most of these improper lookout errors occurred at intersections, rather than in changing lanes, passing, or pulling out from parking spaces (Appendix A, pages A-8 and A-9). Specifically (using in-depth probable level results), 1.4% of accidents resulted from improper lookout "pulling out from parking place," 16.4% "entering travel lane from intersecting street or alley," 2.1% "changing lanes or passing," and 4.0% in "other" situations.

Using the in-depth probable level findings as the criterion for ranking, *excessive speed* is the second-ranking factor. Definite cause results were 7.1/7.9% (B/C). At the probable level, these results were 14.7%/16.9% (B/C). Where excessive speed was cited as a cause, it was most often with respect to road design, rather than weather or traffic conditions (Appendix A, pages A-18 and A-19). Specifically (based on in-depth, probable level results), excessive speed in relation to "road design without regard for existing conditions or traffic" was a cause in 10.2% of Phase II/ III/IV/ V accidents; in light only of "traffic, pedestrians, etc.," in 1.0% of accidents, in light only of "weather conditions" in 2.9% of accidents, and in light of combinations of the above subcategories, in 2.1% of accidents. The "other" category of excessive speed accounted for 0.7% of accidents.

Ranking a close third among these human direct cause categories was *inattention,* which was identified as a definite cause in 8.4/9.8% of accidents (B/C), and a probable cause in 13.9/15.0% (B/C). As in the past (prior to Phase IV), had either on-site or in-depth definite cause figures been used to establish the ranking, inattention would have ranked second, ahead of excessive speed. The most frequent subcategory of inattention cited was "inattention with respect to traffic stopped or slowing ahead" (Appendix A, pages A-3 and A-4). Specifically (based on in-depth, probable data), inattention was a cause with respect to "traffic stopped or slowing ahead" in 5.5% of accidents, with respect to "position of car on road" in 2.6%, to "road feature" (e.g., curve) in 0.7%, to "road signs, signals" in 4.3%, and to "cross-flowing traffic" in 1.7%. "Other" was cited in 1.0% of accidents.

Ranking fourth was *improper evasive action.* This factor was identified as a definite cause in 4.5/4.8% (B/C) of accidents investigated; probable cause results were 10.3/13.3% (B/C). The detailed data tables reveal that the greatest portion of these improper evasive actions involved failure to evade the accident by steering. In about half of these instances, evasive steers were attempted but rendered ineffective due to the front wheels being locked from brake application. The remaining portion of those which involved steering were those in which drivers did not even attempt appropriate evasive steering actions which were available and would have enabled the accident to be avoided. Specifically, for in-depth team probable results, improper evasive action in the sense of "driver's evasive steer was ineffective due to locked front wheels" was a causal factor in 4.8% of accidents, for "driver did not attempt appropriate evasive steer" in 4.5% of accidents, and for "driver could have accelerated out of danger but did not" in 1.0% of accidents. "Other" improper-evasive maneuvers were causes in 4.3% of accidents (Appendix A, page A-22).

Ranking fifth was *internal distraction,* with definite cause findings of 4.0/5.7% of accidents (B/C), and probable level results of 6.1/9.0% (B/C). The predominate type of distraction was conversation with a passenger; specifically (in-depth, probable data), this was a factor in 3.6% of accidents. Events in the car (e.g., dropped cigarettes) were causal distractions in 1.7% of accidents, adjusting radios or tape players in 1.4%, "other" in 2.6% of accidents, while "adjusting windows and other controls" was not cited in-depth (and was cited in only 0.3% of accidents on-site) (Appendix A, pages A-5 and A-6).

Ranking sixth according to Phase II/III/IV/V data was *improper driving technique,* with definite cause results of 2.4/6.0% (B/C) of accidents, and probable level results of 3.9/9.0% (B/C). Results for the specific subcategories of improper driving technique (based on in-depth, probable cause data) were "cresting hills driving in center of road," a cause in 1.4% of accidents; "braking later than should have at inappropriate location" (1.0%); "stopping too far out in road or intersection" (1.0%); "driving too close to center line or edge of road" (0.7%); "slowed too rapidly" (0.2%); and "other" (5.7%) (Appendix A, pages A-15, 16, & 17).

Ranking seventh among these factors was *driving technique inadequately defensive.* Definite causal results for this factor were 2.3/2.4% of accidents (B/C), with probable level results of 4.9/8.8% (B/C). Specifically, inadequately defensive driving technique was a factor in that driver "should have positioned car differently" in 0.5% of accidents, "should have adjusted speed" in 4.3% of accidents, "should not have taken other driver's adherence to traffic sign or signal for granted" in 2.4%; "other" was cited for 1.9% of accidents (in-depth, probable cause results) (Appendix A, pages A-17 and A-18).

Ranking eighth among these human direct categories in combined Phase II/III/IV/V data was the *false assumption* category, with definite cause results of 4.5/8.4% (C/B) of accidents, and probable level results of 8.3/11.8% (C/B). Note that the definition denotes assumptions which are not merely "false," but are also unreasonable or unwarranted. The detailed data tables indicate "other" to be the leading subcategory of false assumption, being cited in 3.6% of accidents according to in-depth, probable cause data (Appendix A, pages A-12 and A-13). Of the remaining subcategories, that most frequently cited was "assumed no traffic was coming" (2.1% of accidents). Often, this category results from the "good samaritan" situation, wherein one motorist motions another to cross his path from the right, giving rise to the assumption that no other traffic is coming from that same direction, when in fact it is. This typically occurs on a road which has more than one lane running the same direction, and on which traffic backs up so as to block an intersecting street, alley, or drive. The detailed data tables show that false assumption was an accident cause (according to in-depth, probable results) in that one driver "assumed other driver was required to stop or yield at intersection," in 1.0% of Phase II/III/IV/V accidents; in that driver "assumed other driver would stop or yield (but not based on assumption of a stop or yield sign or other requirement)," in 1.0% of accidents; in that "assumed on-coming car would move left or right, out of way" in 0.2% (1 accident); in that "assumed vehicle was going to turn and it didn't," in 0.7% (3 accidents); and in that "assumed no traffic was coming," in 2.1% of accidents. "Other" false assumptions were cited in 3.6% of accidents.

Ranking ninth was *improper maneuver,* with definite cause results of 5.0/6.2% (C/B), and probable level results of 6.2/7.1% (C/B). Specifically, these involved "turn from wrong lane" in 2.1% of accidents (in-depth, probable cause data), "driving in wrong lane but correct direction" (e.g., going straight in turn lane) in 0.5% of accidents, "driving in wrong direction of travel for lane" in 0.5% and "passing at improper location" in 1.7% of accidents. "Other" improper maneuvers were tabulated for 1.4% of accidents. Thus, turning from the wrong lane was the improper maneuver which most frequently caused accidents (Appendix A, pages A-14 and A-15).

Ranking tenth among these factors was overcompensation, with definite cause results of 1.8/3.3% (B/C), and probable cause results of 3.2/6.0% (B/C). There are no further sub-categories of this factor, which includes improper road and skid recovery maneuvers (Appendix A, page A-23).

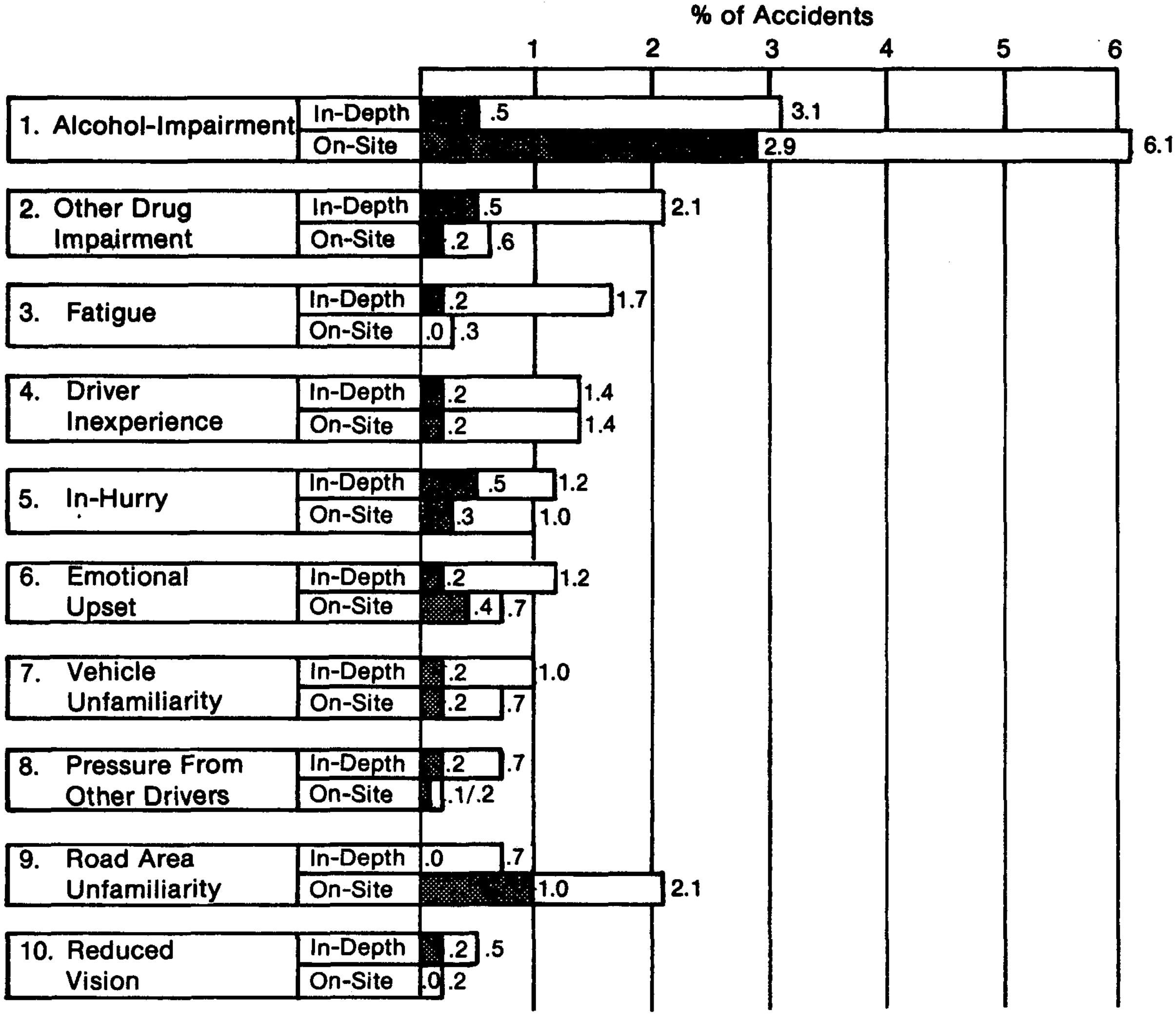
Based on in-depth, probable cause data, the rank of the remaining human direct cause categories among the 15 most frequently cited is inadequate directional control (4.5%), external distraction (4.3%), misjudgment of distance, closure rate, etc., (4.3%), inadequate (or omitted) turn signal (2.9%), and critical non-performance (blacking out, dozing, etc.) (2.1% of accidents).

3.2.3 Human Conditions and States

Conditions and states are defined as factors which adversely affect the ability of a driver as an information processor and vehicle controller. These factors are viewed as "reasons for reasons," the role of which are not easily identified through the clinical case-by-case assessment process. These categories, which include fatigue, driver experience, and alcohol-impairment, are sufficiently remote in their causal relationship that it is difficult to assess their involvement in an individual accident with any assuredness. That is, it is difficult to determine with assurance whether removal or correction of such factors would have prevented a particular accident. However, unusual evidence sometimes does result in such factors being determined to be causally implicated, and in Figure 3-4, the ten most frequently identified conditions or states have been ranked. These results should be viewed as understating the involvement of conditions and states; due to the evidentiary problems mentioned above, they should be viewed as establishing minimum involvement rates. Care has been taken to make assessments regarding the involvement of these factors appropriately conservative.

Figure 3-4

Percentage of Combined Phase II, III, IV, & V Accidents Caused by the Major Human Condition or State Subgroups



From Figure 3-4 it may be seen that **alcohol-impairment was the condition or state most frequently implicated as an accident cause,** using in-depth, probable cause results as the ranking criterion (Phase II/III/IV/V data). Of the 10 condition and state categories for which in-depth probable level involvements occurred (i.e., exceeded zero in the in-depth data), those following alcohol-impairment, in order were: **(2) other drug impairment, (3) fatigue, (4) driver inexperience, (5) in-hurry, (6) emotional upset, (7) vehicle unfamiliarity, (8) pressure from other drivers, (9) road/area unfamiliarity,** and **(10) reduced vision.**

Alcohol-impairment was determined to be a definite cause in 0.5/2.9% (C/B) of the combined Phase II/III/IV/V accidents; probable cause results for alcohol-impairment were 3.1/6.1% (C/B) (Appendix A, pages A-27 and A-28). Since these results span Phases II/III/IV/V they include significant periods in which only accidents occurring between 11:30 a.m. and 10:30 p.m. were investigated. Twenty-four hour per day collection was initiated midway through Phase IV on 4 February 1974, and was maintained throughout Phase V. In Figures 3-5 and 3-6, variations in results for alcohol-impairment are examined as a function of data collection phase and hours of coverage.

It may be seen from Figure 3-5 that the on-site results for alcohol-impairment increased in Phase V, throughout which twenty-four hour/day coverage was maintained, approaching results obtained in Phase I, which also consisted of twenty-four hour/day collection. However, in-depth results in Phase V decreased below the level of Phase IV. Reasons for this unexpected decrease are not known. It could be accounted for by a heretofore unexperienced selection bias.

Figure 3-6 shows Phase IV results for alcohol-impairment both before and after 24 hour/day coverage was initiated, as well as for Phase V, which involved continuous 24 hour/day coverage throughout. For on-site data (top graph), results were about as expected, with Phase IV expanded coverage and Phase V results being similar.

However, in-depth results for Phase V are inexplicitly lower than in the latter part of Phase IV. In fact, except at the possible cause level, Phase V in-depth results (with 24 hr/day coverage) are below those from the "limited-coverage" portion of Phase IV.

It is important that these results for alcohol-impairment, based on the investigation of a representative group of all police-reported accidents, are not confused with the results from the several studies which have examined only serious and fatal accidents, and which have cited alcohol usage as a factor in 40% and more of these serious accidents. Analysis of IRPS' data confirms that alcohol-impairment is more frequently a cause of serious and fatal accidents than of those involving no injury (i.e., 88% of alcohol-involved in-depth cases in Phases II and III were injury producing or fatal accidents, while only 34% of all accidents investigated involved an injury or fatality) (Interim Report I, Volume I). The accident groups examined by IRPS over Phases II/III/IV/V have averaged about 70-80% property damage, 20-30% personal injury, and less than 1% fatal accidents—a distribution which compares favorably with the severity distribution of police-reported accidents nationally (see Section 9.0). These results therefore indicate that where all reported accidents and accident severities are considered (the majority of which are property damage only), **alcohol-impairment may possibly be a cause in up to about 11% of accidents, with a "best estimate" or probable involvement as cause in approximately 7% of all accidents.[3] Again, this should not be confused with higher figures cited elsewhere for only serious and fatal accidents.**

Ranking second among the conditions and states categories was **"other drug impairment"**

[3] Based on Phase V, on-site data, which has varied less erratically than in-depth data and which is probably less influenced by the unwillingness of alcohol-impaired drivers to cooperate (Phase V involved 24 hr./day data collection).

Figure 3-5

Percentage of Accidents in Which Alcohol-Impairment was Judged to be Implicated as an Accident Cause

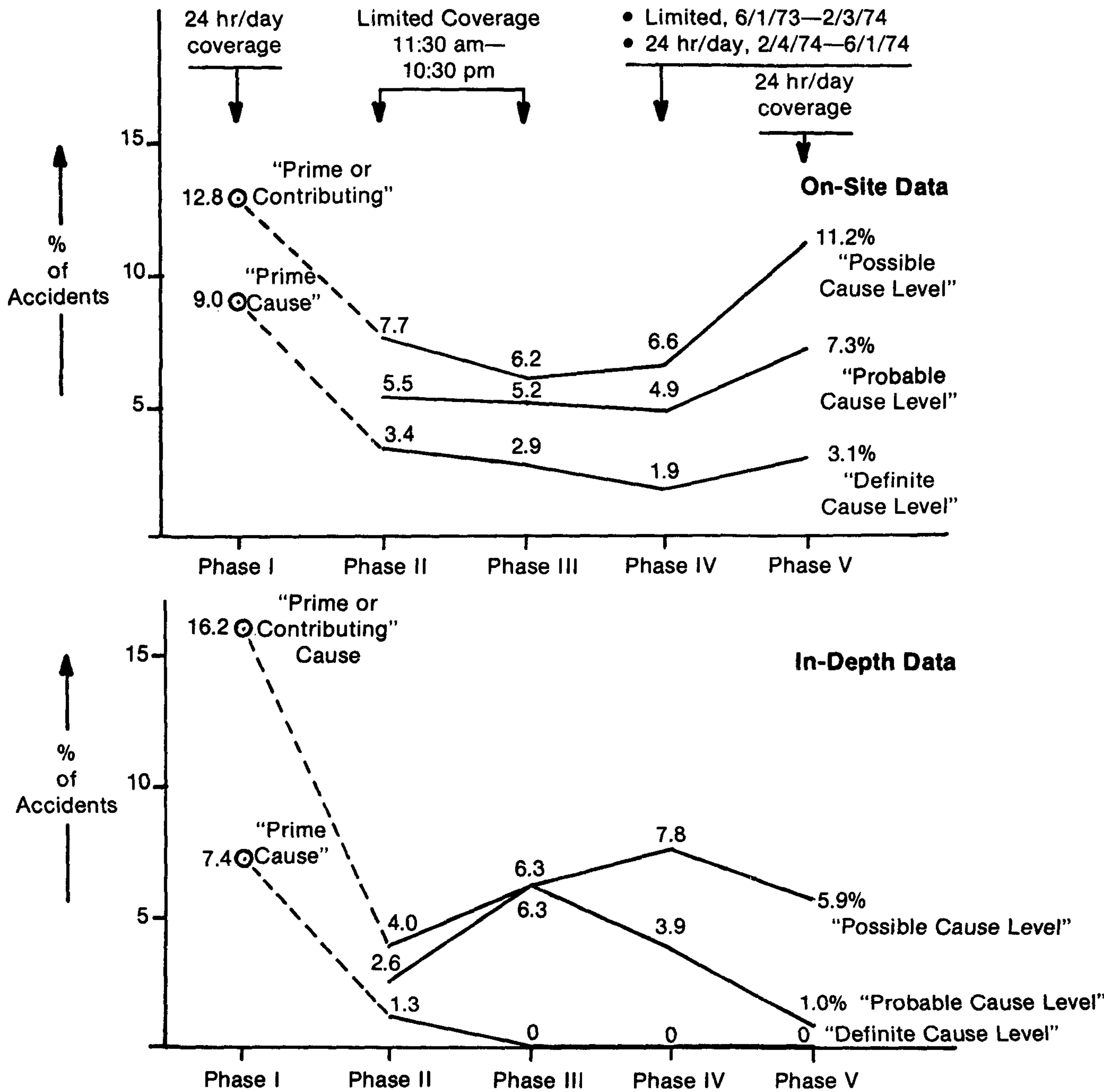
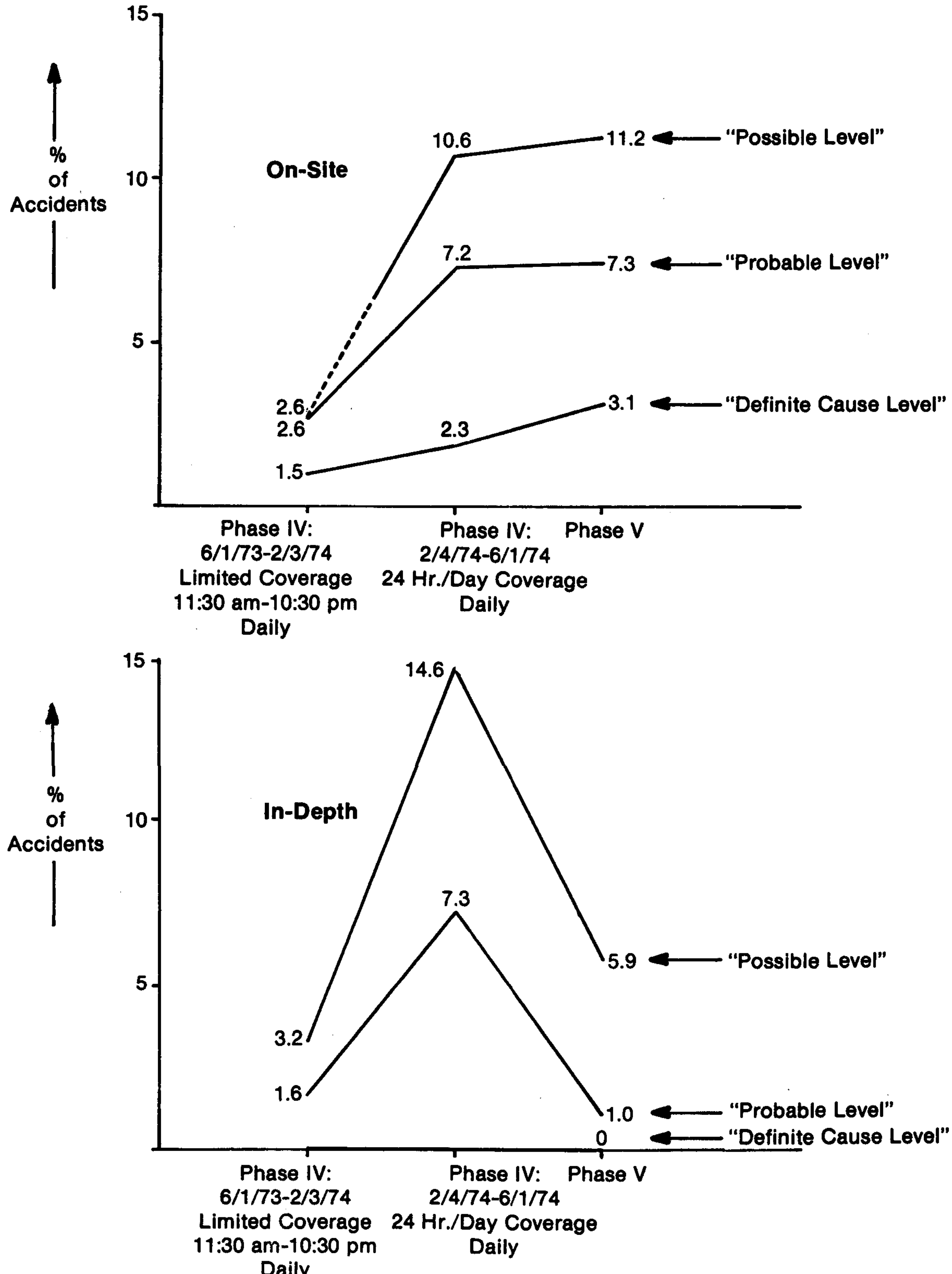


Figure 3-6

Comparison of Results Regarding Involvement of Alcohol-Impairment Before and After Resumption of 24 Hr. Per Day Coverage of Accidents



with definite cause results of .2/.5% (B/C), and probable level results of .6/2.1% (B/C). The detailed data tables (Appendix A, page A-27) reveal that the in-depth team has evaluated "other drug impairment" (i.e., other than alcohol) as a possible cause of up to 4.0% of the combined Phase II/III/IV/V accidents (17 of 420) compared to on-site results of only .08% (19 of 2,258). Across these four phases, in-depth probable level results have been 3.3%, 0.0%, 2.9%, and 0.0%, respectively. Drugs potentially implicated at the possible level or above included marijuana, four cases; depressants, including Doriden, Librium, and Valium, in five cases; antihistamines in 2 cases (one of these being Ornade); and an assortment of other drugs including Mysoline (for control of epileptic seizures), Flagyl (for vaginal infections), Surmician, and cold tablets of unknown type or composition. On-sit :esults, especially at the possible cause level, have generally been below those of the in-depth team, the latter being presumably better equipped to probe drug usage and evaluate its role. Probable level on-site results across Phases II/III/IV/V have been 0.8%, 1.3%, 0.2%, and 0.6%, respectively.

It is suspected that on-site results, which reach a maximum of C.8% at the possible level for combined Phase II/III/IV/V results (compared to a maximum of 4.0% in-depth) reflect instances of visible impairment and admission of use as observed at the accident scene. The in-depth team, on the other hand, carefully probes drug usage in a detailed post-accident interview. Drugs confirmed as being used include both licit drugs such as tranquilizers (e.g., valium) and antihistamines (which may induce drowsiness), and illicit drugs such as marijuana.

Ranking third was **fa.:gue,** with definite cause results of 0.0/0.2% (B/C), probable level results of .3/1.7% (B/C), and possible level results of .6/4.0% (B/C). It appears likely that the in-depth team is more prone to identify fatigue and discern a causal role than is the on-site team. However, probably because of the difficulty in determining the causal relationship, both investigation levels have generally refrained from citing fatigue as a definite cause.

Fourth was **driver inexperience,** with definite cause results of .2/.2% of accidents (B/C), probable level results of 1.4/1.4% (B/C), and possible results of 2.0/2.1% (B/C).

Ranking fifth was the **"in-hurry"** category, with definite cause results of 0.3/0.5% (B/C), probable level resu'' of 1.0/1.2% (B/C), and possible level results of 1.3/3.6% (B/C).

Ranking sixt' **emotional upset,** with definite cause results of 0.2/0.4% (C/B), and probable level re ,f 0.7/1.2% (B/C). Possible cause results for this factor were 1.1/2.1% (B/C).

Ranking seventh was **vehicle unfamiliarity,** with definite cause results of 0.2/0.2% (B/C), probable cause results of 0.7/1.0% (B/C), and possible cause results of 1.1/2.1% (B/C). As with other condition and state categories, these results are intended to include those situations in which lack of familiarity with the vehicle was **involved** as a causal factor, rather than merely a present but non-involved factor. For example, if a driver forgets to depress the clutch of a car with manual transmission and as a result collides with the car ahead, and further discloses that he or she forgot to do so as a result of normally driving a car with an automatic transmission, vehicle unfamiliarity might be tallied as a definite, probable, or possible cause.

Of the condition and state categories, only the seven mentioned above had in-depth, probable level results exceeding 1%. The eighth ranking category was **pressure from other drivers,** with definite cause results of 0.1/0.2% (B/C), probable cause results of 0.2/0.7% (B/C), and possible cause results of 0.4/1.7% (B/C).

Ranking ninth was **road/area unfamiliarity,** with definite cause results of 0.0/1.0% (C/B), probable cause results of 0.7/2.1% (C/B), and possible cause results of 2.9/2.9% (C/B). Note that for this factor, as for several of the condition and state categories, a substantial increase occurs between the probable and possible levels, indicating that in many cases drivers were unfamiliar and this logically could have played a role, although the causal relationship could not be established with assurance.

Ranking tenth was **reduced vision,** which is the last of the condition and state categories for which any entries were made at the probable level in the in-depth team results. Remaining condition and state categories were tallied by the in-depth team as only possible causes, if at all. Reduced vision (a human condition or state denoting a vision impairment or limitation) was identified as the definite cause of one accident in both in-depth and on-site results, out of 420 in-depth and 2,258 on-site investigations conducted during Phases II/III/IV/V (0.0/0.2%, B/C). Probable cause results for reduced vision are 0.2/0.5% (B/C), and possible cause results are 0.4/1.9% (B/C).

No probable level results have been tallied for **physical handicap, chronic illness, mental deficiency,** or **road/area overfamiliarity,** in the 420 in-depth investigations summarized here.

3.2.4 Environmental Factors

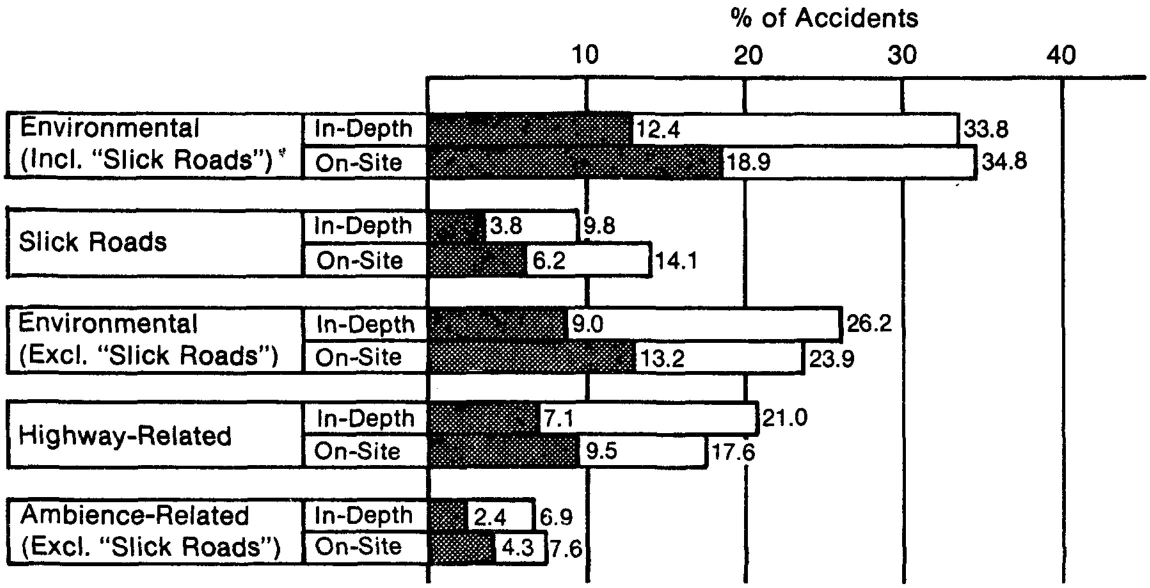
Environmental causal factors ranked between human and vehicular factors in frequency of involvement, being identified as definite causes in 12.4/18.9% (C/B) of accidents, probable causes in 33.8/34.9% (C/B), and possible causes of 44.2/46.0% (B/C). These results refer to environmental factors with the slick roads category included (Appendix A, page A-32).

Figure 3-7 shows the involvement of environmental factors, both including and excluding the slick roads category. **Slick roads,** including both those which were ice or snow covered and those which were merely rain-slickened, were identified as definite causes in 3.8/6.2% of accidents (C/B), were probable causes in 9.8/14.1% (C/B), and were possible causes in 13.1/17.0% (C/B).

Also shown in Figure 3-7 are results for environmental factors with the "slick roads" category excluded. (Note that these figures do not result from simple subtraction of slick road results, since a particular accident may involve both slick roads and other environmental factors). Definite cause results for environmental factors with the slick roads category excluded were 9.0/13.2% (C/B), with probable level results of 23.9/26.2% (B/C), and possible level results of 32.2/37.4% (B/C). Of the two categories immediately below "environmental factors (excluding slick roads)" in the causal hierarchy, "highway-related" factors ranked first and "ambience-related factors (excluding slick roads)" ranked second, as shown in Figure 3-7. Definite cause results for all highway-related factors were 7.1/9.5% (C/B), with probable level

Figure 3-7

Percentage of Combined Phase II, III, IV, & V Accidents Caused by the Major Environmental Factor Subgroups



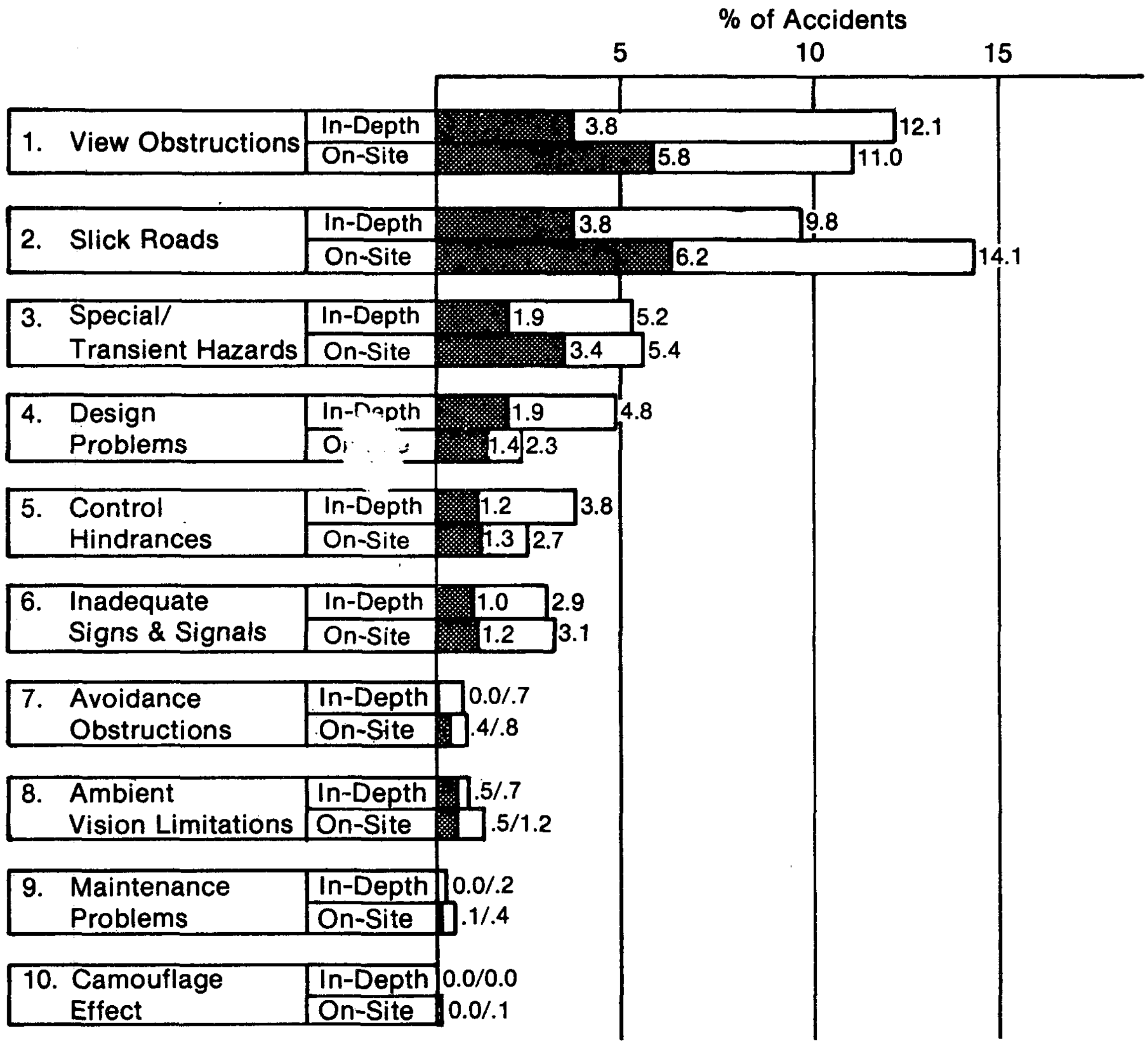
results of 17.6/21.0% (B/C), and possible level results 23.6/28.1% (B/C). Definite cause results for ambience-related factors (excluding slick roads) were 2.4/4.3% (C/B), with probable level results of 6.9/7.6% (C/B), and possible cause results of 10.9/13.1% (B/C).

Figure 3-8 ranks factors from yet a lower level in the environmental hierarchy. Factors which appear under the highway and ambience-related headings, as well as slick roads, have been put in a common pool and ranked without regard to their original (higher) classification. It can be seen that **according to in-depth, probable cause results, view obstructions are the most frequent environmental cause of accidents.** View obstructions were definite causes in 3.8/5.8% of accidents (C/B), with probable cause results of 11.0/12.1% (B/C) and possible cause results of 14.6/16.4% (B/C). Of the view obstruction sub-categories, the most frequently cited was "hedges, signs, and other roadside structures or vegetation." Ranking second among the view-obstructions sub-categories was that for parked vehicles, which are particularly a problem in limiting sight distances at urban intersections. Specifically, according to in-depth, probable cause data, view obstructions in the nature of "hill crests, dips, etc.," were a factor in 1.2% of accidents, "roadside embankments, escarpments, etc.," in 1.7%, "roadside structures and growth" in 5.5%, "stopped traffic (not parked)" in 1.9%, "parked vehicles" in 3.3%, and "other view obstructions" in 0.7% of accidents (Appendix A, pages A-40 and A-41).

Ranking second was **slick roads,** with definite cause results of 3.8/6.2% (C/B), probable

Figure 3-8

Percentage of Combined Phase II, III, IV, & V Accidents Caused by Specific Environmental Causal Factors



cause results of 9.8/14.1% (C/B), and possible cause results of 13.1/17.0% (C/B). Rain-slicked and snow or ice covered roads accounted for most of the entries under this category, with the road wet category only slightly exceeding results for snow/ice in the in-depth data (probable results 4.5% vs. 3.6%) (Appendix A, page A-32). However, at the probable cause level, the on-site team cited wet roads more than twice as often as snow/ice (8.1% vs. 3.7%).

In-depth, probable cause results for the specific slick roads sub-categories were: "road wet," 4.5% of accidents; "road snow and/or ice covered," 3.6% of accidents; "gravel and/or sand on pavement," 1.0%; "road slick due to traffic polishing," 0.5%; "wet and traffic polished asphalt," 0.2%; "gravel road," not cited (0.0%); and, "other problems," 0.5% of accidents.

Ranking third among the specific environmental causal factors was the **special/transient hazards** category, with definite cause results of 1.9/3.4% (C/B), probable cause results of 5.2/5.4% (C/B), and possible cause results of 6.7/8.6% (B/C) (Appendix A, pages A-45 and A-46). The most commonly cited sub-category of special hazards, accounting for approximately two-thirds of instances cited, was for "non-contact vehicle caused problem." The special hazards category, as defined in the glossary, refers to so-called "phantom vehicles" which cause problems, such as by forcing another vehicle off the road, but are not themselves involved. Ideally, the reason for the errant behavior of the non-contact vehicles would be discerned, and appropriately allocated to human, vehicular, or environmental factors. However, such non-contact vehicles ordinarily continue on, and are not available for investigation as a part of the accident they may have caused. Hence, for consistency, all such events are tallied under the "transient hazards" category.

In-depth probable cause results for transient hazards sub-categories were: "animal in road," 0.7% of accidents; "object in road," 0.2% (1 accident of 420); "non-contact vehicle caused problem," 3.8%; and "vehicle stopped in road," 0.5%.

Ranking fourth among these specific environmental factors was **design problems,** with definite cause results of 1.4/1.9% (B/C), probable cause results of 2.3/4.8% (B/C), and possible cause results of 3.1/7.4% (B/C). The most frequently cited sub-category of design problems has been "road overly narrow, twisting, etc.," which characterizes many rural Monroe County roads; entries for this sub-category account for approximately one-half of the design problem entries. Ranking second of the sub-categories was "intersection design problems" (Appendix A, pages A-42 and A-43). Specifically, in-depth probable cause results for design problems subcategories were: "accesses insufficiently limited or improperly placed," not cited in-depth; "intersection design problems," 1.2%; "road overly narrow, twisting, etc.," 2.9%; "trees and other objects too close to road," not cited in-depth; and "other design problems," 1.0% of accidents.

Ranking fifth was **control hindrances,** with definite cause results of 1.2/1.3% (C/B), probable level results of 2.7/3.8% (B/C), and possible level results of 3.5/4.5% (B/C). "Drop-off at pavement edge" was the leading sub-category according to both on-site and in-depth data, accounting for approximately one-third of all control hindrances identified by the in-depth team. In-depth, probable cause results for the control hindrance sub-categories were: "drop-off at pavement edge," 1.2% of accidents; "excessive road crowns," 0.2%; "improperly banked curves," 0.2%; "soft shoulders," not cited; "ditches, embankments, and other roadside features," 0.5%; "unexpected wet or slick spots," 0.7%; and "other control hindrances," 1.0%.

Ranking sixth was the **inadequate signs and signals** category, with definite cause results of 1.0/1.2% (C/B), probable cause results of 2.9/3.1% (C/B), and possible cause results of

5.5/5.6% (C/B). Detailed data tables reveal that results are widely distributed across the sub-categories (Appendix A, pages A-37-40). The on-site teams have cited factors falling within the "other" sub-category more than the remaining sub-categories. However, of those sub-categories remaining, differences are apparent between on-site and in-depth results; the on-site team has most frequently cited the category "stop sign needed but not provided," followed by "curve warning signs needed." The in-depth frequencies are low, with "stop sign needed but not provided" and "curve sign present but not adequate" each cited three times (0.7% of accidents), and "curve warning signs needed" cited twice. Other sub-categories were cited only once or not at all at the probable level in the in-depth data.

Avoidance obstructions were the seventh-ranking environmental factor. Combined Phase II/III/IV/V definite cause results for avoidance obstructions were 0.0/0.4% (C/B), with probable cause results of 0.7/0.8% (C/B), and possible cause results of 1.1/1.2% (B/C). In-depth, probable cause results for avoidance obstruction sub-categories were: "parked or stopped traffic," 0.5%; "trees and other fixed objects," 0.2%; and "other," 0.2% (1 accident in 420).

Ranking eighth was **ambient vision limitations,** with definite cause results of 0.5/0.5% of accidents (C/B), probable cause results of 0.7/1.2% (C/B), and possible cause results of 2.4/2.4% (C/B). With respect to on-site results, the leading sub-category of ambient vision limitation was "glare from sun." The few in-depth entries were evenly distributed at the possible level. The most frequent entries (three each) were for "glare from sun" and "glare from headlights."

Ranking ninth was **maintenance problems,** with definite cause results of 0.0/0.1% (C/B), probable cause results of 0.2/0.4% (C/B). Possible cause results were also 0.2/0.4% (C/B), with the latter percentages representing 1 accident out of 420 in-depth, and 10 out of 2,258 on-site investigations. The in-depth entry was for "traffic control sign or signal obscured." Within the on-site data, five of these accidents were tallied for "traffic control sign or signal obscured," four for "other problems," and one for "traffic control sign missing" (Appendix A, pages A-42 and 43).

Ranking tenth was **camouflage effect,** with definite cause results of 0.0/0.0% (C/B), probable cause results of 0.0/0.1% (C/B), and possible cause results of 0.5/1.0% (B/C). At the possible level, this amounted to 11 accidents on-site (0.5% of 2,258), and 4 accidents in-depth (1.0% of 420).

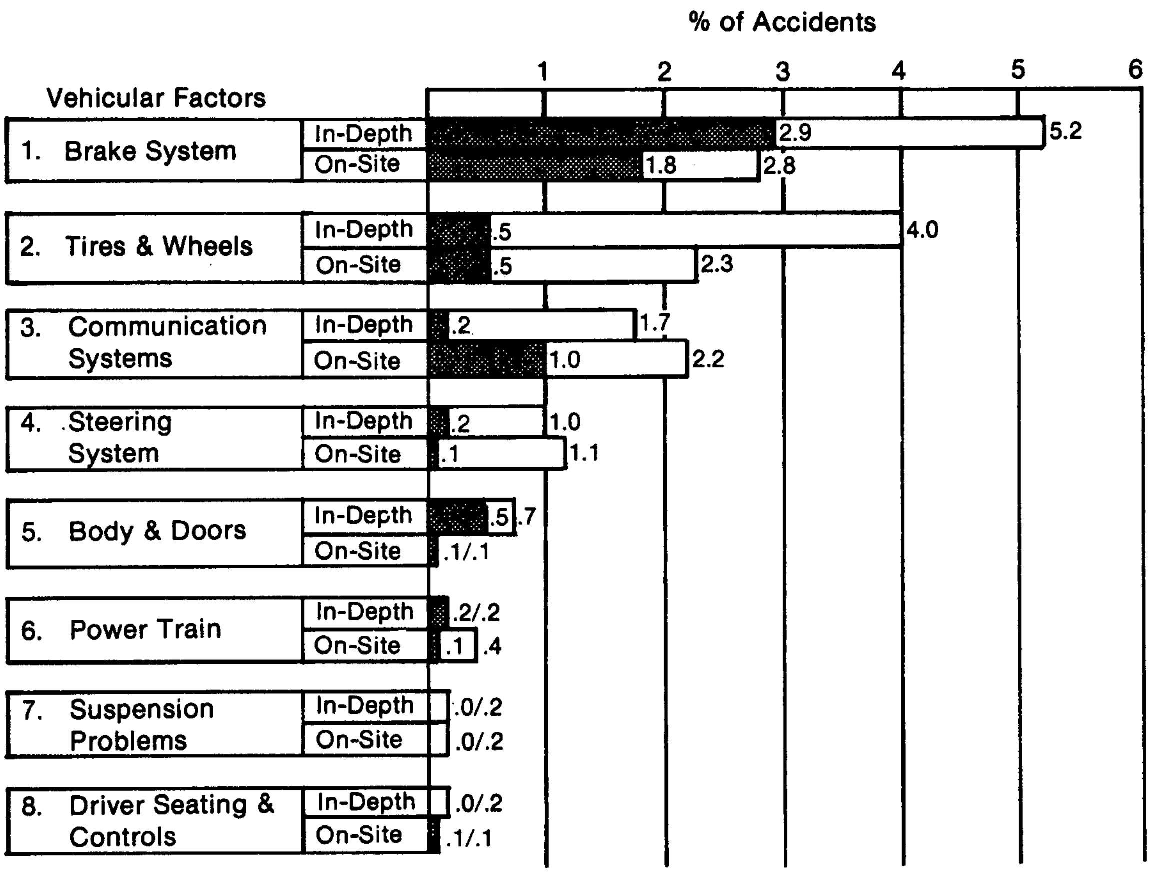
3.2.5 Vehicular Factors

Vehicular factors were identified as accident causes less frequently than either human or environmental factors; they were definite causes of 4.1/4.5% (B/C) of the combined Phase II/III/IV/V accidents, with probable cause results of 9.1/12.6% (B/C) and possible cause results of 14.7/25.2% (B/C) (Appendix A, page A-52).

Figure 3-9 shows the rank of the major vehicular causal factor categories. Ranking first was the **brake system problems** category, with definite cause results of 1.8/2.9% (B/C), probable

Figure 3-9

Percentage of Combined Phase II, III, IV, & V Accidents Caused by Deficiencies in Major Vehicular Systems



cause results of 2.8/5.2% (B/C), and possible cause results of 4.6/7.6% (B/C). A summary of vehicle causation results is also presented in Table 3-3.

The detailed data tables reveal that **of the brake problems which caused accidents, the leading problem was gross failures (front and/or rear);** according to in-depth team data, these were definite causes in 1.9% of accidents (8 of 420), probable causes of 3.1% (13 of 420), and possible causes of 3.6% (15 of 420) (Appendix A, pages A-54-58). These "gross failures" amounted to about 59% (13 of 22) of all causative brake problems (based on in-depth probable cause data). Of the 13 definite or probable gross failures tallied by the in-depth team out of 420 Phase II/III/IV/V accidents considered, three were cited as resulting from wheel cylinder loss or failure, 3 from brake line failure, two as the result of a master cylinder problem, none from insufficient brake fluid level, two as the result of adjustment mechanism loss or failure,

Table 3-3

Causal Involvement of Vehicle Factors in Phases II through V

Vehicular Problem	Highest Certainty Level* ("Certain") On-site n	%	In-depth n	%	Probable Level** (Includes "Certain" cases) On-site n	%	In-depth n	%	Possible*** (Includes "Certain" and "Probable") On-site n	%	In-depth n	%
A. All Vehicular Problems	92	4.1	19	4.5	205	9.1	53	12.6	333	14.7	106	25.2
B. Brake System	40	1.8	12	2.9	64	2.8	22	5.2	104	4.6	32	7.6
1. Gross Failure—front and/or rear	34	1.5	8	1.9	43	1.9	13	3.1	58	2.6	15	3.6
2. Delay—pumping required	2	0.1	0	0	9	0.4	1	0.2	15	0.7	2	0.5
3. Side-to-side imbalance	1	0.0	4	1.0	7	0.3	8	1.9	15	0.7	11	2.6
4. Premature lockup or grab	1	0.0	0	0	2	0.1	0	0	4	0.2	1	0.2
5. Performance degraded—other reasons	2	0.1	0	0	3	0.1	1	0.2	12	0.5	5	1.2
C. Tires & Wheels	11	0.5	2	0.5	51	2.3	17	4.0	85	3.8	37	8.8
1. Inflation	2	0.1	0	0	7	0.3	7	1.7	9	0.4	19	4.5
2. Inadequate tread depth	6	0.3	1	0.2	39	1.7	11	2.6	67	3.0	18	4.3
3. Blowout	1	0	0	0	2	0.1	0	0	3	0.1	0	0
4. Mismatch of tire types or sizes	0	0	0	0	0	0	0	0	3	0.1	2	0.5
5. Wheel loss or failure	1	0.0	1	0.2	1	0.0	1	0.2	1	0.0	1	0.2
6. Other problems	2	0.1	0	0	5	0.2	1	0.2	7	0.3	4	1.0
D. Communication Systems	22	1.0	1	0.2	49	2.2	7	1.7	78	3.5	22	5.2
1. Vehicle lights and signals	7	0.3	0	0	14	0.6	3	0.7	23	1.0	13	3.1
2. Vehicular view obstruction	15	0.7	1	0.2	36	1.6	4	1.0	54	2.4	9	2.1
3. Auditory (horn, ambient noise)	0	0	0	0	0	0	0	0	3	0.1	1	0.2
4. Other problems	0	0	0	0	0	0	0	0	0	0	0	0
E. Steering System	3	0.1	1	0.2	25	1.1	4	1.0	47	2.1	15	3.6
1. Excessive freeplay	1	0.0	1	0.2	19	0.8	3	0.7	37	1.6	10	2.4
2. Binding (undue effort required)	0	0	0	0	0	0	1	0.2	1	0.0	1	0.2
3. Freezing/locking	0	0	1	0.0	0	0	1	0.0	3	0.1	1	0.2
4. Other problems	2	0.1	0	0	5	0.2	1	0.2	6	0.3	5	1.2
F. Body & Doors	2	0.1	2	0.5	2	0.1	3	0.7	5	0.2	3	0.7
1. Door came open (pre-crash)	1	0.0	1	0.2	1	0.0	2	0.5	3	0.1	2	0.5
2. Hood came open (pre-crash)	1	0.0	1	0.2	1	0.0	1	0.2	1	0.0	1	0.2
3. Other problems	0	0	0	0	0	0	0	0	1	0.0	0	0
G. Power Train & Exhaust	3	0.1	1	0.2	8	0.4	1	0.2	11	0.5	4	1.0
1. Power loss or hesitation	3	0.1	1	0.2	8	0.4	1	0.2	11	0.5	2	0.5
2. Exhaust system	0	0	0	0	0	0	0	0	0	0	2	0.5
3. Other problems	0	0	0	0	0	0	0	0	0	0	0	0
H. Suspension Problems	1	0.0	0	0	5	0.2	1	0.2	11	0.5	6	1.4
1. Shock absorber problems	1	0.0	0	0	4	0.2	0	0	7	0.3	1	0.2
2. Spring problems	0	0	0	0	0	0	0	0	3	0.1	2	0.5
3. Other problems	0	0	0	0	1	0.0	1	0.2	2	0.1	3	0.7
I. Driver Seating & Controls	3	0.1	0	0	3	0.1	1	0.2	11	0.5	3	0.7
1. Driver controls	3	0.1	0	0	3	0.1	1	0.2	10	0.4	3	0.7
2. Driver anthropometric	0	0	0	0	0	0	0	0	1	0.0	0	0
3. Other problems	0	0	0	0	0	0	0	0	0	0	0	0
J. Other Vehicle Problems	8	0.4	0	0	13	0.6	0	0	20	0.9	2	0.5

* "Causal-certain"; means to a high degree of assuredness, but for this deficiency, there would have been no accident.

** "Certain or probable, causal or severity-increasing."

*** "Certain, probable, or possible, causal or severity-increasing." Represents a fairly speculative judgment that a deficiency was present and *might* have influenced the accident's occurrence or severity.

NOTE: On-site N = 2,258; In-depth N = 420.

with 6 cases being tallied under **"gross failure for other reasons."** (In one accident, more than two sub-categories were cited).

Ranking second among the brake problem sub-categories in the in-depth data was "side-to-side imbalance," which was cited in eight of the 22 accidents tallied as definite or probable causes. It was a definite cause of 1.0% of the in-depth accidents (4 of 420), a probable cause of 1.9% (8 of 420), and a possible cause of 2.6% (11 of 420). Together, gross failures and imbalances were cited in 21 of the 22 accidents which, according to in-depth probable cause data, were caused by brake system problems.

After gross failures and imbalances, in-depth probable cause results for the remaining brake problem sub-categories were: "delayed braking response/pumping required," a factor in 1 accident (0.2%), "brakes grabbed, locked prematurely, or were over-sensitive," not cited at probable level (and cited only once as a possible cause), and "performance degraded for other reasons," cited in 1 accident (0.2%).

Ranking second among the vehicle cause categories was **tires and wheels,** with definite cause results of 0.5/0.5% (B/C), probable cause results of 2.3/4.0% (B/C), and possible cause results of 3.8/8.8% (B/C). Underinflation and inadequate tread depth were the predominant entries under this category (Appendix A, pages A-52, 53 and 54). According to in-depth probable cause data, "inadequate tread depth" was the most frequently cited category of tires and wheels, being cited in 2.6% of accidents (11 of 420). Ranking second was "inflation," a factor in 1.7% of accidents (7 of 420): six of these seven cases involved underinflation, with the remaining case being one of over-inflation. These two leading sub-categories (tread depth and inflation) were identified by the in-depth team as possible causes in 4.3 and 4.5% of accidents, respectively.

Of the remaining tires and wheels sub-categories, according to in-depth probable cause data, wheel loss or failure was cited once (0.2% of accidents), as were "other tire or wheel problems." No in-depth entries occurred at either the probable or possible cause levels for either "mismatch of tire types and/or sizes" or "blow out/sudden failure."

However, the former **was** identified as a possible cause in 3 of 2,258 accidents investigated on-site (0.1%). The latter factor, blow-out/sudden failure, was identified by the on-site team as a definite cause in one accident of the 2,258 (0.04%), as a probable cause in one additional accident, and as a possible cause in a third. **Thus, blow-outs were evaluated by the on-site teams to be a definite, probable, or possible cause of 3 of the 2,258 accidents they investigated (0.1%).**

Ranking third among the vehicular cause categories was communication systems, with definite results of 0.2/1.0% (C/B), probable cause results of 1.7/2.2% (C/B), and possible cause results of 3.5/5.2% (B/C) (Appendix A, pages A-63-69).

Among the categories of communication systems problems, both "lights and signals" and "vehicle-related vision obstructions" were frequently cited, the latter including such factors as snow or condensation-obstructed windows. The in-depth team implicated "vision obstructions" as probable causes of 4 accidents (1.0%), while the on-site team cited this factor in 36 accidents (1.6%). At the probable level the in-depth team implicated "lights and signals" in 3 accidents (0.7% of 420), compared to 14 on-site (0.6% of 2,258). The in-depth team was prone to cite the "lights and signals" category at the possible level; they were cited by the in-depth team as possible causes of 13 accidents (3.1%), exceeding possible cause results for "vision-obstructions" (9 accidents, 2.1%). On-site cited "vision obstructions" as possible causes in 54 accidents (2.4%), while "lights and signals" were possible causes in 23 of the on-site investigated accidents (1.0%).

Of the "lights and signals" problems, the "inoperable stop light" category predominated in the in-depth data (possible cause in 4 accidents, 1.0%), while turn signals and tail lights predominated on-site (possible causes in 9 and 10 accidents, respectively; approximately 0.4% each). Significantly, inoperable headlamps (including "one-eyed" vehicles) were rarely implicated (possible cause of 1 in-depth accident, 0.2%; not cited as even a possible cause in **any** of the 2,258 on-site investigations). Of the vehicle-related vision obstruction problems, while in-depth entries are so sparse as to make interpretation of doubtful utility, it may be generalized that both on-site and in-depth, "ice, snow, frost, water, or condensation on windows," predominated (possible cause of 4 in-depth accidents, 1.0%; and 28 on-site accidents, 1.2%). This was followed by "inoperable or deficient vision hardware" (possible cause of 4 in-depth accidents, 1.0%; and 13 on-site accidents, 0.6%). Of these hardware problems, at the possible level, the on-site team cited defrosters twice, mirrors and wipers once each, and washers were not cited. In-depth cited mirrors twice and defrosters once, and did not cite either wipers or washers.

Ranking fourth among the vehicular categories was the **steering system** category, with definite results of 0.1/0.2% (B/C), probable cause results of 1.0/1.1% (C/B), and possible cause results of 2.1/3.6% (B/C). "Excessive freeplay" was the most frequent sub-category of steering problems, being cited in well over half of all steering problem accidents, both on-site and in-depth. It was a probable cause of 3 in-depth (0.7%) and 19 on-site (0.8%) accidents, and a possible cause of 10 in-depths (2.4%) and 37 on-sites (1.6%). "Binding" and "freezing or locking" were each cited as possible causes once in-depth (0.2% of accidents), while the former was also cited as possible cause once on-site and the latter three times (0.0% and 0.1% of accidents, respectively). Several entries also occurred under "other" (Appendix A, pages A-58 and A-59).

Ranking fifth was the category **body and doors,** with definite cause results of 0.1/0.5% (B/C), probable cause results of 0.1/0.7% (B/C), and possible cause results of 0.2/0.7% (B/C). At the possible level, this amounts to 3 entries in-depth and 5 entries on-site. Of the 3 in-depth entries, two were for doors coming open (pre-crash), while the third was for "hood came open" (Appendix A, pages A-72 and 73). Of the five on-site entries, three were for doors coming open, one for a hood coming open, and one for an "other body and door" problem.

Ranking sixth was the **power train and exhaust** category, with definite cause results of 0.1/0.2% (B/C), probable cause results of 0.2/0.4% (C/B), and possible cause results of 0.5/1.0% (B/C). These possible cause results reflect a total of 4 entries out of 420 in-depth accidents, and 11 entries out of 2,258 on-site accidents. Two of these four in-depth cases involved a power loss or hesitation, with factors other than running out of fuel being cited as the reason for both (Appendix A, pages A-62 and 63). In the remaining two in-depth accidents tallied, leakage of carbon monoxide into the driver's compartment was cited as a possible causal factor. All 11 of the on-site entries were for power loss, with one of these being cited as resulting from running out of fuel, and the other 10 being attributed to other reasons.

Ranking seventh was the **suspension problems** category, with definite cause results of 0/.04% (C/B), probable cause results of 0.2/0.2% (C/B), and possible level results of 0.5/1.4% (B/C). At the possible level, this amounts to six in-depth entries and 11 on-site entries. Entries were minimal in-depth; "spring problems" were cited as possible causes twice (0.5%), shock absorber problems once (0.2%), while "other" was cited three times. In the on-site data, shock absorber problems predominated, being cited as possible causes of 7 accidents (0.3%), compared to 3 accidents for springs (0.1%), and 2 accidents for "other suspension problems" (0.1%). The on-site entries under shock absorber problems were all for "weak shock absorbers," while the sole in-depth entry was for a missing shock absorber. A "raised rear-end" accounted for all of the in-depth spring problems and two of the three on-site problems; the remaining on-site case involved a missing spring (Appendix A, pages A-60, 61, & 62).

Ranking eighth was the **driver seating and controls** category, with definite cause results of 0/0.1% (C/B), probable cause results of 0.1/0.2% (B/C), and possible cause results of 0.5/0.7% (B/C). At the possible level, this amounted to three entries in-depth and 11 entries on-site (Appendix A, pages A-70 and 71). The three in-depth entries were for "driver controls;" one of these was a "steering wheel problem" (e.g., spinner snagged clothing), while the remaining two (0.5%) were "accelerator problems (e.g., stuck)." Of the 11 on-site possible cause entries, 10 fell under the "driver controls" category, with the greatest number (five) being for "accelerator problem (e.g., accelerator stuck)." The remaining five "driver control" entries on-site were for steering wheel problems (cited twice), brake pedal problems (once), and "other" driver control problems (twice). The remaining (eleventh) case cited by on-site under "driver seating and controls" was for "driver anthropometric/seat loose or became detached."

In Figure 3-10, the major sub-categories which made up the brake systems, tires and wheels, communication systems, and other vehicular categories, have been put in a common pool and ranked, without regard to these original (higher) classifications. As before, the in-depth probable cause results have been used to establish the ranking.

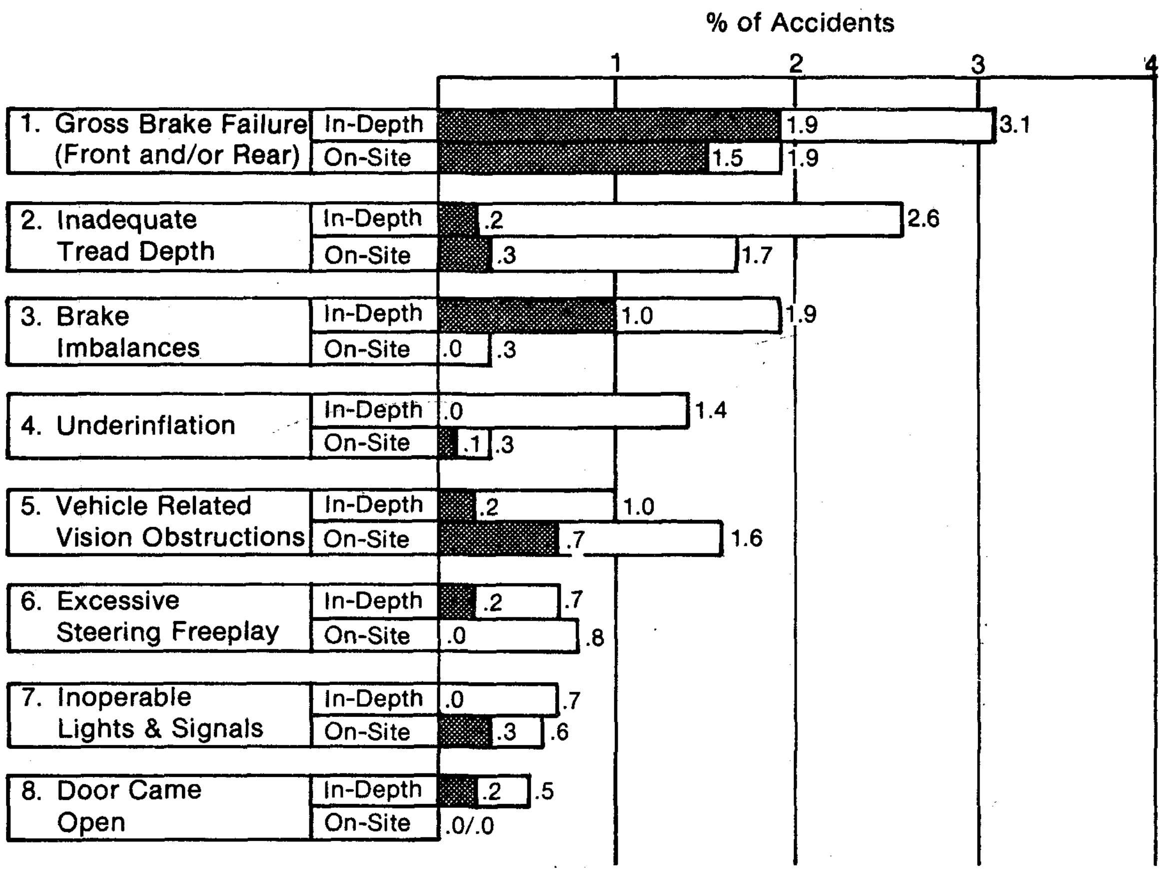
It may be seen that "gross brake failure" of all or a part of the braking system was the most frequent specific vehicular causal factor. Ranking second was "inadequate tread depth," third was "side-to-side brake imbalances," followed by "under-inflation," "vehicle-related vision obstructions," "excessive steering freeplay," "inoperable lights and signals," and "door came open."

3.3 Causal Results: Alternate Presentation Format

Figure 3-11 shows the relationship between the presentation format of Section 3.2 and the

Figure 3-10

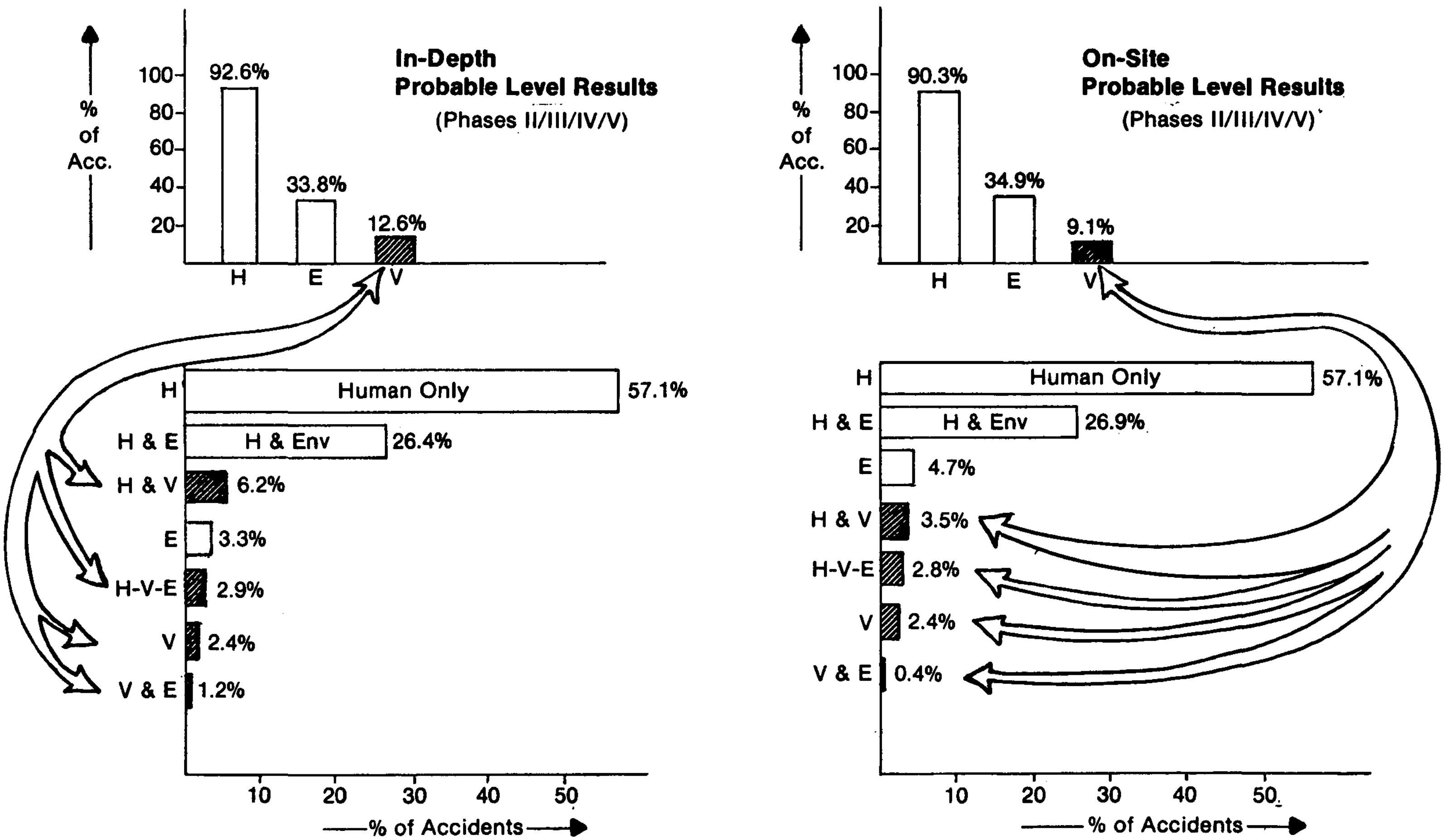
Percentage of Combined Phase II, III, IV, & V Accidents Caused by Specific Vehicular Deficiencies



alternative presentation format of the present section. Note that as presented in Section 3.2, the percentage results for the human, environmental, and vehicular factors total in excess of 100% for both on-site and in-depth data. This is because, as shown in Figure 3-11, there was frequently more than one kind or type of factor involved as a cause in each accident. Thus, using probable level results for comparison, it may be seen from Figure 3-11 that **human factors alone were identified as probable causes in 57.1% of accidents investigated** by the in-depth team, which means no vehicular or environmental factors were identified as either definite or probable causes in these accidents; i.e., in these accidents, environmental and vehicular factors were either not identified, or were only identified at the possible level. It may further be seen that **combinations of both human and environmental factors were identified**

Figure 3-11

Comparison of Result Presentation Formats



as either definite or probable causes in 26.4% of these in-depth accidents. In these accidents, vehicular factors either were not identified, or were identified only as possible causes. Ranking next in the in-depth (probable level) results were human and vehicular factors, 6.2%; followed by environmental factors, 3.3%; human, vehicular and environmental factors, 2.9%; vehicular factors alone, 2.4%; and combinations of vehicular and environmental factors, 1.2%.

Note that if percentage results from the lower format for each bar containing a vehicular factor are totaled, the sum is the overall in-depth probable level result for vehicular factors of 12.6% of accidents. The same relationship pertains for both human and environmental factors.

Turning to on-site results, Figure 3-11 indicates that **human factors alone were definite or probable causes in 57.1% of on-site investigated accidents,** meaning that in these accidents environmental and vehicular factors either were not identified as causes, or were identified only at the possible level. Ranking next within these on-site (probable level) results were the combination of human and environmental factors, accounting for 26.9%; followed by environmental factors alone, 4.7%; human and vehicular factors, 3.5%; the combination of human vehicular, and environmental factors, 2.8%; vehicular factors alone, 2.4%; and the combination of vehicular and environmental factors, 0.4%.

Note that these rankings and related percentages are quite similar in both on-site and in depth data. The ranking for the on-site data differs from that for in-depth only in that a reverse occurs between "environmental only" and the combination of "human and environmental."

The data summarized in Figure 3-11 are presented in greater detail in Table 3-4, which in turn has been extracted from a computer printout. In addition to the probable level results just discussed, Table 3-4 also provides definite and possible cause data, as well as breaking these results out both cumulatively and for individual phases.

In Figure 3-12, definite, probable, and possible cause data from cumulative Phases II/III/IV/V (taken from Table 3-4), have been graphed in a manner facilitating comparison between level B and C results, which are generally similar.

Care must be taken in examining these results. Note, for example, that between the definite and probable level results of Figure 3-12, percentages for "human only" decrease, while those for the combination of "human and environmental" factors increase. This indicates that there are many accidents in which human factors alone were cited as definite causes (i.e., in the causal-certain cell), but in which environmental factors were tallied as probable level causes (i.e., as certain or probable causal or severity-increasing factors). **Thus, an accident having a certain human cause and a probable environmental cause, would be tallied as "human only" under "definite cause" results, but as "human and environmental" under "probable cause" results. This accounts for "human only" being higher at the definite cause level, for this particular type of presentation.**

The changes which occur between assuredness levels make interpretation of this section difficult. However, by concentrating on the probable cause level, the main point that emerges is that slightly over half of the accidents were solely attributable to driver problems. Of course,

Table 3-4

Percentage of Accidents Caused by Human, Vehicular, and Environmental Factors Alone and In Combination.

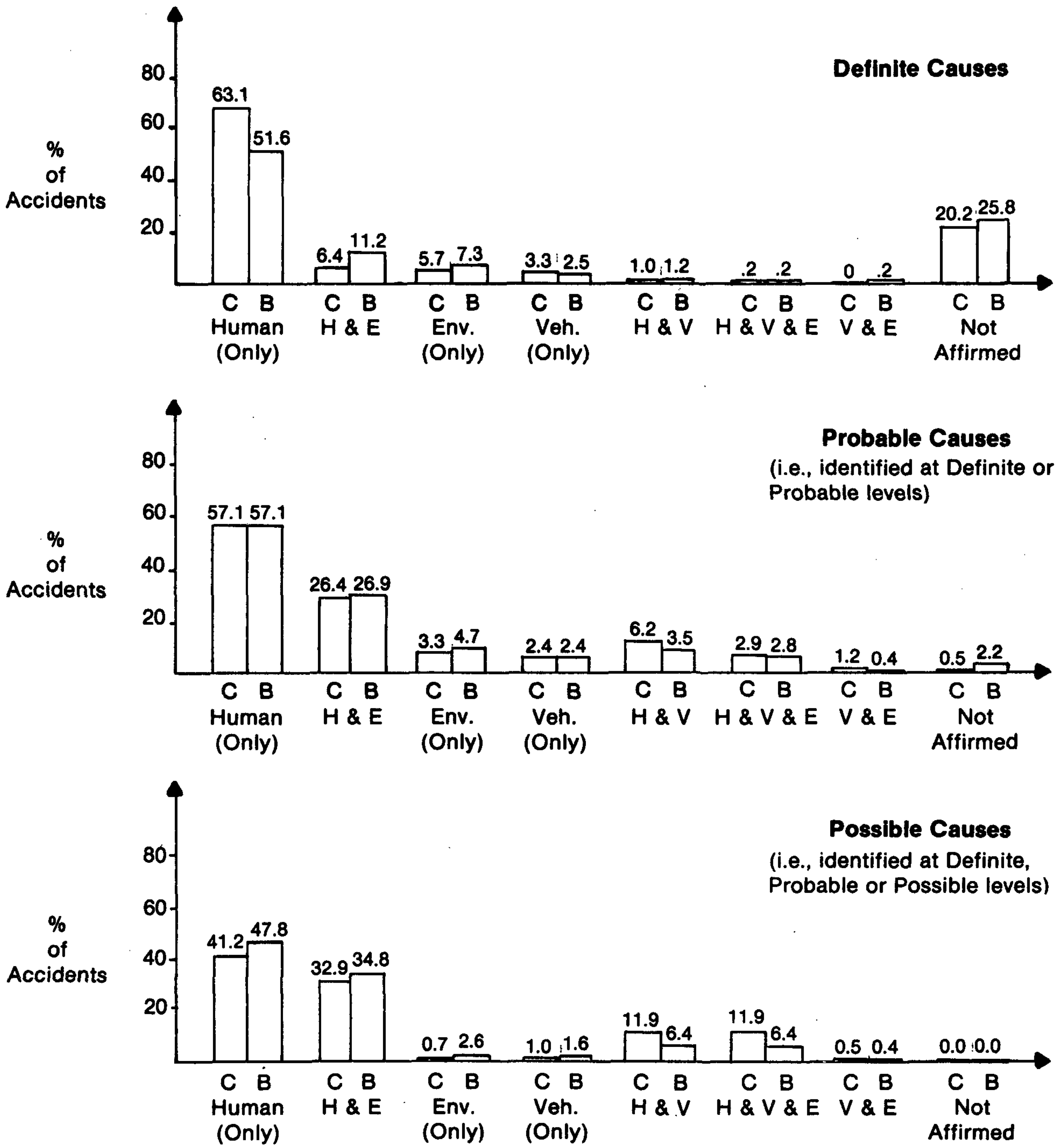
Causal Factor	Definite Causes[1]										Probable Causes										Possible Causes									
	Phase II		Phase III		Phase IV		Phase V		All Phases		Phase II		Phase III		Phase IV		Phase V		All Phases		Phase II		Phase III		Phase IV		Phase V		All Phases	
	B	C	B	C	B	C	B	C	B	C	B	C	B	C	B	C	B	C	B	C	B	C	B	C	B	C	B	C	B	C
Human Only (H)	55.8	69.5	60.8	73.4	53.0	61.2	45.2	49.0	51.6	63.1	48.1	54.3	52.0	65.6	58.5	54.4	63.4	58.8	57.1	57.1	34.0	42.4	47.1	53.1	50.2	35.9	54.8	37.3	47.8	41.2
Environment Only (E)	7.5	4.6	4.2	4.7	7.6	6.8	8.1	6.9	7.3	5.7	5.3	0.0	2.0	3.1	3.8	4.9	5.8	6.9	4.7	3.3	2.6	0.0	1.6	0.0	1.9	1.0	3.4	2.0	2.6	0.7
Vehicle Only (V)	3.6	3.3	2.3	0.0	2.5	3.9	1.9	4.9	2.5	3.3	2.0	2.6	2.3	0.0	2.5	1.9	2.2	4.9	2.4	2.4	1.3	0.0	1.3	0.0	1.7	1.0	1.8	2.9	1.6	1.0
H & E	13.8	11.9	20.3	7.8	13.3	2.9	5.4	1.0	11.2	6.4	31.5	27.8	35.6	28.1	26.1	30.1	21.7	19.6	26.9	26.4	40.6	30.5	38.6	34.4	33.7	37.9	30.8	30.4	34.8	32.9
H & V	2.5	2.0	.3	0.0	1.9	0.0	.3	1.0	1.2	1.0	5.7	10.6	2.9	3.1	4.5	3.9	1.7	3.9	3.5	6.2	8.3	14.6	5.6	7.8	7.0	10.7	5.1	11.8	6.4	11.9
V & E	.2	0.0	.7	0.0	.2	0.0	0.0	0.0	.2	0.0	0.0	.7	.7	0.0	.6	1.9	.4	2.0	0.4	1.2	.6	.7	.7	0.0	.6	1.0	.1	0.0	.4	.5
H & V & E	.6	.7	.3	0.0	.2	0.0	0.0	0.0	.2	.2	5.3	4.6	3.3	0.0	2.7	2.9	1.3	2.0	2.8	2.9	12.6	11.9	5.2	4.7	4.7	12.6	4.0	15.7	6.4	11.9
Not Affirmed	16.0	7.9	11.1	14.1	21.4	25.2	39.1	37.3	25.8	20.2	1.5	0.0	1.3	0.0	1.3	0.0	3.4	2.0	2.2	0.5	0.0	0.0	0.0	0.0	.2	0.0	0.0	0.0	0.0	0.0

[1] *Definite means* "Causal Certain." Probable means "Certain or Probable, Causal or Severity-Increasing." Possible means "Certain, Probable, or Possible; Causal or Severity-Increasing." Not affirmed means no factor was cited at the Certainty Level being presented.

Note: Total "N" is: Phase II, Level B-530, Level C-151; Phase III, Level B-306, Level C-64; Phase IV, Level B-528, Level C-103; Phase V, Level B-894, Level C-102.
Explanation: For example, this table indicates that human factors alone were probable causes of 48.1% of the Phase II, Level B accidents. This means that in these accidents human factors were cited as either definite or probable cause, but there were no environmental or vehicular factors cited as either definite or probable causes. See text for further explanation.

Figure 3-12

Percentage of Accidents Caused by Human, Vehicular, and Environmental Factors Alone and in Combination—During Phases II, III, IV & V (combined)



the countermeasures for these problems could be new developments in either vehicles or the environment, but within the existing state-of-the-art, in these 50% + accidents, there is no defined deficiency within current standards in either vehicles or the environment which played a causative role. Even at the possible level, 40 to 50% of the accidents involved human errors alone, meaning that vehicular and environmental problems were not considered to be even possible causes in this proportion of accidents. This means that even being rather speculative concerning potential vehicle and environmental involvement, drivers appeared clearly and solely at-fault in 40 to 50% of these accidents.

The other point is that many accidents involved combinations of human and environmental problems; e.g., given a view obstruction, a driver may be cited for an improper lookout in failing to make reasonable, appropriate efforts to overcome it. It may therefore be concluded that the vast majority of accidents are due either to (1) human errors alone or (2) human errors in combination with environmental deficiencies. Based on the probable cause data, these two groups account for about 84% of the accidents investigated, according to both on-site and in-depth data (Table 3-4 and Figure 3-12).

3.4 Focused Examinations

3.4.1 Introduction

Within the four broad categories of causal factors—(1) human direct causes, (2) human conditions and states, (3) environmental causes and (4) vehicular causes—two of the most frequently cited specific factors were the direct human causes labeled **improper lookout** and **inattention.** At the time the causal factors were first defined, it was impossible to predict their frequency in accidents. Now that these factors have emerged as major accident causes, it is meaningful to examine them in more detail. The detailed examinations which follow entailed further categorization within each of these factors. It was hoped that the additional breakdowns would be sufficiently detailed to aid in the development of accident countermeasures. Since all of these analyses were post hoc, they involved a manual reexamination of the raw accident files. A reexamination of all accident cases containing the relevant causes would have therefore been impossible within time and cost constraints of the project. Instead, a random sample of 150 cases, each containing at least one of the two causes, was analyzed. The sample cases were reexamined, and the revised causal assessment consisted of a more detailed taxonomy of the two causes mentioned above. A report on this examination is provided below.

Vehicle accident causes were in general the least-cited but their practical implications are the most obvious—both for manufacturing standards and the identification of vehicle defects, as well as for vehicle inspection programs. To seek data relevant to these issues, all cases in which vehicle causes were cited were reanalyzed by an automotive engineer with particular emphasis being placed upon brake problems, since these constituted the most frequently cited vehicle factors. This analysis is reported in Appendix D.

Focused examinations of environmental accident causes were centered around the category of view obstructions. For this purpose all cases in which view obstructions were causally implicated were reexamined by an accident reconstruction specialist in an attempt to find patterns of environmental characteristics that may have interacted with the driver's behavior and together led to the accident. Results of this examination appear in Appendix E.

3.4.2 Improper Lookout

Improper lookout was originally defined as a recognition error in a situation requiring a distinct visual surveillance activity "in which the driver either did not look or did look but did so inadequately" (i.e., "looked but did not see"). Because improper lookout typically occurs at intersection-type road configurations (74% of the drivers committing an improper lookout had their accidents in intersections), the original category confounded at least three independent factors which in the present analysis were separated as follows:

1. *Looking vs. Seeing*
   1.1 The driver (or other evidence) indicates that he/she looked in the relevant directions but failed to see the other car.
   1.2 The driver is uncertain as to whether he/she looked or not.
   1.3 The driver did not look in the relevant direction.
2. *Obstructed vs. Unobstructed View*
   2.1 Lookout view was obstructed, necessitating extra caution.
   2.2 Lookout view was not obstructed.
3. *Terminated vs. Ongoing Lookout*
   3.1 At the time of the accident, the driver was still visually scanning the relevant parts of the visual field.
   3.2 The driver had ended his/her visual surveillance.

The observed frequencies (and percentages) in the ten logically possible combinations are presented in Table 3-5. These results indicate that:

• People involved in accidents due to improper lookout errors look and do not "see" just as often as they do not look at all. Therefore, it is likely that driver training that emphasizes the overt head turning behavior rather than the actual information acquisition process is not likely to lead to a significant reduction in accidents caused by improper lookout. It is likely that a certain percent of those failures are due to preoccupation with other thoughts. The experimental psychology literature is replete with studies showing that processing of externally-presented information is interfered with when the person is occupied in other mental tasks (e.g., Shulman and Greenberg, 1971). Nonetheless, it is also likely that to some extent the failure to process relevant information may be due to interference from other attention-demanding external objects. The clutter of visual information is highly characteristic

Table 3-5

Frequencies (and Cell Percentages) of Various Situations Involved in Accidents Resulting from Improper Lookout

View Obstructed	Driver Still Scanning	Driver Looked n (%)	Unknown n (%)	Driver Did Not Look n (%)	TOTAL n (%)
Yes	Yes	4 (9)	1 (2)	*	5 (11)
	No	3 (7)	2 (4)	8 (17)	13 (28)
No	Yes	3 (7)	1 (2)	*	4 (9)
	No	9 (20)	4 (9)	11 (24)	24 (52)
TOTAL		19 (41)	8 (17)	19 (41)	46 (100)

* This cell represents a logically impossible combination.

of intersections that are often filled with redundant signs and irrelevant information such as billboard displays within the driver's sight distance.

• The majority of the sample drivers (80%) are not scanning their visual field at the time of the accident; i.e., their surveillance activity has been concluded prior to the moment of collision. It is possible that training to continue scanning after entering intersections would eliminate some of the accidents, though it might result in an increase in other types of accidents (e.g., rear-end collisions into cars directly ahead). The trade off between the two could be investigated in further research.

• View obstructions are present in 39% of these accidents, suggesting that an improper lookout is a driver behavior that exists independently of the presence of physical objects that may otherwise make a proper lookout more difficult. These results are consistent with the notion that much of the improper lookout is due to competing internal mental activities. In fact, it is possible that view obstructions even act as attention-drawing factors, since there appears to be ($p = .227$) a greater tendency to continue scanning in the presence of view obstructions than in the absence of view obstructions (see Table 3-6).

These results indicate that one effective countermeasure might be a direct instruction to scan particular areas in the visual field. Such signed information would then be located at accident-prone intersections, where a driver's lookout behavior is likely to be impaired either due to competing external stimuli or to internal thought processes. To some extent, even the latter is predictable since it is more likely that drivers may be internally distracted in the vicinity of places such as hospitals and bars. A practical approach to the conditioning of caution behavior that could be applied in such situations has been outlined recently by Parsons (1976).

Table 3-6

Scanning Behavior With and Without View Obstructions

View Obstruction	Driver Still Scanning Yes n	%	No n	%	Total n	%
Yes	5	27.8	13	72.2	18	39.1
No	4	14.3	24	85.7	28	60.9
Total	9	19.6	37	80.4	46	100.0

Fisher exact probability = .227

In order to make driver education recommendations, a normative frequency table for the non-accident or general population drivers is necessary. Thus, comparing frequencies within the above table only is merely half the story. Unobtrusive observation of driver behavior in selected intersections is now needed to obtain exposure information that would allow the drawing of more meaningful conclusions from these data.

3.4.3 Inattention

Inattention is defined in part as an "unnecessary wandering of the mind, or a state of being engrossed in thoughts or matters not of immediate importance to the driving task;" i.e., it implies an internalization of attention or preoccupation.

Two independent variables were of interest in this analysis:

1. *The "Cause" of the Preoccupation*
   1.1 The driver was preoccupied with a specific thought.
   1.2 The driver was just in a reduced state of alertness.
2. *The Existence of Precipitating Conditions or States that Caused the Accident*
   2.1 A causally-related condition was identified.
   2.2 No such condition was identified.

The four possible combinations of these two variables are presented in Table 3-7, along with the observed frequencies (and percentages) of each.

As Table 3-7 shows, as often as not (57% vs. 43%), the driver could not identify the specific thought with which he was preoccupied. It is likely that at least in some of the cases in which no such specific preoccupation was identified, the reason was due to retroactive inhibition. That is, the events during the accident masked previous thoughts or information that was in short-term memory just prior to the accident. The effect is a very common one, and was particularly likely to have played a role when the interview was held several days after the accident. It is also

Table 3-7

Relationship between Preoccupation with Specific Thought and Presence of a Precipitating Human Condition or State

Driver Occupied with a Specific Thought	Presence of a Precipitating Human Condition or State					
	Yes		No		Total	
	n	%	n	%	n	%
Yes	6	37.5	10	62.5	16	57.1
No	2	16.7	10	83.3	12	42.9
Total	8	28.6	20	71.4	28	100.0

Fisher exact = .218

possible to argue that in the 12 cases where the specific preoccupation was not identified, a more appropriate causal factor would have been "delayed recognition for other reasons."

In over 70% of the cases, no precipitating states were causally implicated. It was originally expected that a higher frequency of such states and conditions would be identified in the cases of preoccupation with specific thoughts (e.g., in a hurry, emotionally upset) than when no specific thoughts could be identified. The data indicated trends in this direction (38% vs. 17%), but they are not statistically significant (Fisher Exact Probability = .218). Thus, the above breakdown of the inattention category does not seem to provide any additional insights—either about the process itself or about potential countermeasures.

It should be noted that while inattention here is defined as a "yes" or "no" (dichotomous) factor (i.e., either did or did not play a role), the underlying phenomenon is a measure of mental effort that varies continuously over time (Kahneman, 1973). Furthermore, evidence obtained in other contexts (vigilance, prolonged psycho-physical testing, fatigue) indicates that this variation may be cyclic. To the extent that the variation is dependent on environmental characteristics, countermeasures can be designed. To illustrate, there is a common belief that overall attention level drops in the absence of a continuously stimulating environment, possibly during freeway or desert driving for instance. If such specific sites can be identified, then thoughts to attention-arousing devices can be directed. It is difficult, however, to conceive of a countermeasure that will continuously keep a driver alert all the time that he or she is on the road (other than the vehicle-installed devices aimed at preventing the driver from falling asleep, c.f. Hulbert, 1972).[4]

[4] Note: Focused examinations of leading vehicular and environmental causes are reported in Appendices D and E of this volume, respectively.

3.5 Analysis of Vehicle Causal Factors by Vehicle Age

3.5.1 Introduction

In Section 3.7 of *Interim Report I* (1), the model year distribution of vehicles involved in accidents as a result of vehicular problems was compared with that of all Monroe County registered vehicles. It was found that these distributions varied significantly (.001 level), with the older model year vehicles tending to be overrepresented among those having causative vehicular deficiencies. This overrepresentation began with the 1965 model year and became progressively worse for older vehicles, such that the class of **1962 and older vehicles constituted 22.7% of accident vehicles having causative vehicular problems, but only 6.4% of the registered vehicle population.** This tendency was found to hold true for the major vehicular problem subcategories, as well; older vehicles were overrepresented among vehicles having causative brake system problems, and the same was true for those having causative tire and wheel or steering system problems.

For *Interim Report II* (2), an analysis was conducted to update and verify that finding. At the same time, vehicle age was used rather than model year in order to better deal with problems caused by the fact that the accidents investigated have been examined over a period of time (i.e., a given model year has become progressively older across the four year-long phases reported). The previous analysis *(Interim Report I)* was based on Phase II/III on-site data, providing 88 vehicles for which a vehicular factor was cited at the probable level or above (i.e., cited as certain or probable, causal or severity-increasing). For *Interim Report II*, the addition of Phase IV, comprised of 528 accidents, produced an additional 46 vehicles assessed as having causative vehicular problems at the probable level, bringing total vehicles available for analysis to 134 out of a total of 2,351 vehicles in the accidents investigated. The results of the *Interim Report II* analyses were similar to those achieved earlier, indicating that older vehicles were overly involved in accidents resulting from vehicular problems (although not necessarily overrepresented in accidents per se — possibly due to being driven fewer miles per year). The over-involvement began with vehicles seven years of age, and held true for all of the older age categories with the exception of the fifteenth year, for which accident vehicles were minimal in number (5 vehicles of 2,351 total). **Vehicles seven years of age and older comprised only 33.4% of the accident-involved vehicles investigated, but 59.1% of those with causative vehicle problems** (an over-involvement of 59.1/33.4 or 1.8 for these older vehicles). The oldest age class tabulated, comprised of vehicles 17 years of age or older, was considerably over-involved; these vehicles comprised only 1.9% of accident-involved vehicles (44 of 2,351), but 6.0% of vehicles having causative problems (8 of 134), an over-involvement of 3.2.

3.5.2 Results of Final Analyses

Data collected in Phase V were used to update the on-site findings published in *Interim Report II.* In addition, the increased sample size allowed assessment of the relationship between vehicle age and causation to be made based on the in-depth sample. The distribution of vehicles involved in accidents due to their own mechanical problems was compared with the distribution of all other accident vehicles.

The six tables which follow (Tables 3-8 through 3-13) present both on-site and in-depth results at the definite, probable, and possible cause levels, based on cumulative Phase II, III, IV and V data. Frequency and relative frequency distributions for culpable and non-culpable accident-involved vehicles are presented along with appropriate Chi-square statistics (significance levels) and involvement ratios. The involvement ratio (IR) of age group i is defined as:

$$IR_i = \frac{\text{Proportion of culpable accident-involved vehicles in age group } i}{\text{Proportion of non-culpable accident-involved vehicles in age group } i}$$

Probable level results are further summarized in Table 3-14, which combines vehicle age into three major groups for both on-site and in-depth distributions.

In general, the earlier findings as presented in *Interim Reports I* and *II* were reaffirmed, with vehicle age distributions for culpable and non-culpable accident-involved vehicles being found to vary significantly in each of the six comparisons. Older vehicles are overrepresented among vehicles having accidents on account of their degradations, failures, or other vehicular problems.

In the probable cause tables (Tables 3-9 and 3-12), this over-involvement is shown to begin with the seventh (on-site) and eighth (in-depth) years of age and to continue for older classes of vehicles in both sets of data (See also Figure 3-13). Younger vehicles are correspondingly underrepresented in the culpable class.

These data are further summarized in Table 3-14, which combines the same data from the probable cause level into three age groups: (1) one to three years; (2) four to seven years; (3) eight years and older. For the on-site data, vehicles one to three years old comprise about 41% of "all other accident vehicles," but comprise only 20% of vehicles involved due to vehicle problems (involvement ratio .49). Similarly, vehicles four to seven years comprised about 37% of "all other accident vehicles," but only 32% of "vehicles involved due to vehicular problems" (involvement ratio .88). For vehicles eight years and older, however, although these comprised only 23% of "all other accident vehicles," they comprised about 48% of vehicles involved due to vehicular problems, an over-involvement of 2.1.

In-depth data for these combined age groups are remarkably similar (Table 3-14), and the resultant involvement ratios are virtually identical for each group.

In summary, based on both on-site and in-depth probable cause data from Phases II through V, **beginning with about the seventh or eighth year of vehicle age, an over-involvement in accidents resulting from mechanical problems begins.** Table 3-14 shows that, both on-site and in-depth, the probability of a vehicle 8 years of age or older causing an accident (by virtue of a mechanical problem) is 2.1 times greater than for vehicles in general.

Table 3-8

Age Distributions of Vehicles Involved in Accidents due to Vehicle Problems, All Other Accident-Involved Vehicles, and Total Accident-Involved Vehicles, Based on In-Depth, Definite Cause Data from Phases II, III, IV and V. (I.e., based on causal-certain data).

Age	Vehicles Involved Due to Vehicle Problems N	Vehicles Involved Due to Vehicle Problems %	All Other Accident Vehicles N	All Other Accident Vehicles %	Involvement Ratio	Total Accident Vehicles N	Total Accident Vehicles %
1	1	5.9	97	16.0	.37	98	15.7
2	0	0	74	12.2	.00	74	11.9
3	1	5.9	60	9.9	.60	61	9.8
4	2	11.8	67	11.1	1.1	69	11.1
5	0	0	62	10.2	.00	62	10.0
6	2	11.8	47	7.8	1.5	49	7.9
7	1	5.9	54	8.9	.66	55	8.8
8	0	0	45	7.4	.00	45	7.2
9	1	5.9	38	6.3	.94	39	6.3
10	1	5.9	25	4.1	1.4	26	4.2
11	3	17.6	16	2.6	6.8	19	3.0
12	0	0	7	1.2	.00	7	1.1
13	2	11.8	3	0.5	23.6	5	0.8
14 & older	3	17.6	11	1.8	9.8	14	2.2
Totals	17	100.0	606	100.0	—	623	100.0

$\overline{X}^2 = 64.1$ $p \leq .001$

Table 3-9

Age Distributions of Vehicles Involved in Accidents due to Vehicle Problems, All Other Accident-Involved Vehicles, and Total Accident-Involved Vehicles, Based on In-Depth, Probable Cause Data from Phases II, III, IV and V. (i.e., based on certain or probable, causal or severity-increasing data).

Age	Vehicles Involved Due to Vehicle Problems N	%	All Other Accident Vehicles N	%	Involve-ment Ratio	Total Accident Vehicles N	%
1	4	8.0	94	16.4	.49	98	15.7
2	2	4.0	72	12.6	.32	74	11.9
3	3	6.0	58	10.1	.59	61	9.8
4	5	10.0	64	11.2	.89	69	11.1
5	2	4.0	60	10.5	.38	62	10.0
6	7	14.0	42	7.3	1.9	49	7.9
7	3	6.0	52	9.1	.66	55	8.8
8	4	8.0	41	7.2	1.1	45	7.2
9	5	10.0	34	5.9	1.7	39	6.3
10	4	8.0	22	3.8	2.1	26	4.2
11	4	8.0	15	2.6	3.1	19	3.0
12	1	2.0	6	1.0	2.0	7	1.1
13	2	4.0	3	0.5	8.0	5	0.8
14 & older	4	8.0	10	1.7	4.7	14	2.2
Totals	50	100.0	573	100.0	—	623	100.0

$\bar{X}^2 = 33.6$ $p \leq .01$

Table 3-10

Age Distributions of Vehicles Involved in Accidents due to Vehicle Problems, All Other Accident-Involved Vehicles, and Total Accident-Involved Vehicles, Based on In-Depth, Possible Cause Data from Phases II, III, IV and V. (i.e., based on certain, probable, or possible, causal or severity-increasing data).

Age	Vehicles Involved Due to Vehicle Problems N	%	All Other Accident Vehicles N	%	Involvement Ratio	Total Accident Vehicles N	%
1	9	9.1	89	17.0	.54	98	15.7
2	7	7.1	67	12.8	.55	74	11.9
3	6	6.1	55	10.5	.58	61	9.8
4	10	10.1	59	11.3	.89	69	11.1
5	3	3.0	59	11.3	.27	62	10.0
6	12	12.1	37	7.1	1.7	49	7.9
7	6	6.1	49	9.4	.65	55	8.8
8	8	8.1	37	7.1	1.1	45	7.2
9	11	11.1	28	5.3	2.1	39	6.3
10	6	6.1	20	3.8	1.6	26	4.2
11	7	7.1	12	2.3	3.1	19	3.0
12	4	4.0	3	0.6	6.7	7	1.1
13	2	2.0	3	0.6	3.3	5	0.8
14 & older	8	8.1	6	1.1	7.4	14	2.2
Totals	99	100.0	524	100.0	—	623	100.0

$\overline{X}^2 = 57.5$ $p \leq .001$

Table 3-11

Age Distributions of Vehicles Involved in Accidents due to Vehicle Problems, All Other Accident-Involved Vehicles, and Total Accident-Involved Vehicles, Based on On-Site, Definite Cause Data from Phases II, III, IV and V. (I.e., based on causal-certain data).

Age	Vehicles Involved Due to Vehicle Problems N	Vehicles Involved Due to Vehicle Problems %	All Other Accident Vehicles N	All Other Accident Vehicles %	Involvement Ratio	Total Accident Vehicles N	Total Accident Vehicles %
1	6	7.5	583	17.2	.44	589	16.9
2	6	7.5	392	11.5	.65	398	11.4
3	4	5.0	392	11.5	.43	396	11.4
4	2	2.5	344	10.1	.25	346	9.9
5	4	5.0	308	9.1	.55	312	9.0
6	8	10.0	314	9.2	1.1	322	9.3
7	6	7.5	277	8.2	.91	283	8.1
8	14	17.5	227	6.7	2.6	241	6.9
9	3	3.7	201	5.9	.63	204	5.9
10	5	6.3	141	4.1	1.5	146	4.2
11	6	7.5	94	2.8	2.7	100	2.9
12	2	2.5	55	1.6	1.6	57	1.6
13	4	5.0	17	0.5	10.0	21	0.6
14 & older	10	12.5	53	1.6	7.8	63	1.8
Totals	80	100.0	3398	100.0	—	3478	100.0

$\overline{X}^2 = 113.4$ $p \leq .001$

Table 3-12

Age Distributions of Vehicles Involved in Accidents due to Vehicle Problems, All *Other Accident-Involved Vehicles, and Total Accident-Involved* Vehicles, Based on On-Site, Probable Cause Data from Phases II, III, IV and V. (i.e., based on certain or probable, causal or severity-increasing data).

Age	Vehicles Involved Due to Vehicle Problems N	%	All Other Accident Vehicles N	%	Involvement Ratio	Total Accident Vehicles N	%
1	12	7.1	577	17.4	.40	589	16.9
2	9	5.3	389	11.8	.40	398	11.4
3	13	7.7	383	11.6	.60	396	11.4
4	11	6.5	335	10.1	.64	346	9.9
5	14	8.3	298	9.0	.92	312	9.0
6	13	7.7	309	9.3	.83	322	9.3
7	16	9.5	267	8.1	1.2	283	8.1
8	21	12.4	220	6.6	1.9	241	6.9
9	16	9.5	188	5.7	1.7	204	5.9
10	9	5.3	137	4.1	1.3	146	4.2
11	12	7.1	88	2.7	2.6	100	2.9
12	5	3.0	52	1.6	1.9	57	1.6
13	5	3.0	16	0.5	6.0	21	0.6
14 & older	13	7.7	50	1.5	5.1	63	1.8
Totals	169	100.0	3309	100.0	—	3478	100.0

$\overline{X}^2 = 96.5 \quad p \leq .001$

Table 3-13

Age Distributions of Vehicles Involved in Accidents due to Vehicle Problems, All Other Accident-Involved Vehicles, and Total Accident-Involved Vehicles, Based on On-Site, Possible Cause Data from Phases II, III, IV and V. (i.e., based on certain, probable, or possible, causal or severity-increasing data).

Age	Vehicles Involved Due to Vehicle Problems N	%	All Other Accident Vehicles N	%	Involvement Ratio	Total Accident Vehicles N	%
1	27	10.0	562	17.5	.57	589	16.9
2	16	5.9	382	11.9	.50	398	11.4
3	20	7.4	376	11.7	.63	396	11.4
4	23	8.5	323	10.5	.81	346	9.9
5	22	8.1	290	9.0	.90	312	9.0
6	23	8.5	299	9.3	.91	322	9.3
7	25	9.2	258	8.0	1.2	283	8.1
8	31	11.4	210	6.5	1.8	241	6.9
9	29	10.7	175	5.5	1.9	204	5.9
10	12	4.4	134	4.2	1.0	146	4.2
11	16	5.9	84	2.6	2.3	100	2.9
12	6	2.2	51	1.6	1.4	57	1.6
13	6	2.2	15	0.5	4.4	21	0.6
14 & older	15	5.5	48	1.5	3.7	63	1.8
Totals	271	100.0	3207	100.0	—	3478	100.0

$\overline{X}^2 = 87.4$ $p \leq .001$

Table 3-14

Distributions of Vehicle Ages for Major Age Groups Based on Phase II, III, IV and V Probable Level Results. (i.e., certain or probable, causal or severity-increasing data).

ON-SITE DATA

Age Groups	Vehicles Involved Due to Vehicle Problems N	%	All Other Accident Vehicles N	%	Involvement Ratio	Total Accident Vehicles N	%
1-3 yrs.	34	20.1	1349	40.8	.49	1383	39.8
4-7 yrs.	54	32.0	1209	36.5	.88	1263	36.3
8 yrs. & older	81	47.9	751	22.7	2.1	832	23.9
Totals	169	100.0	3309	100.0	—	3478.	100.0

$\bar{X}^2 = 60.97$ $p \leq .001$

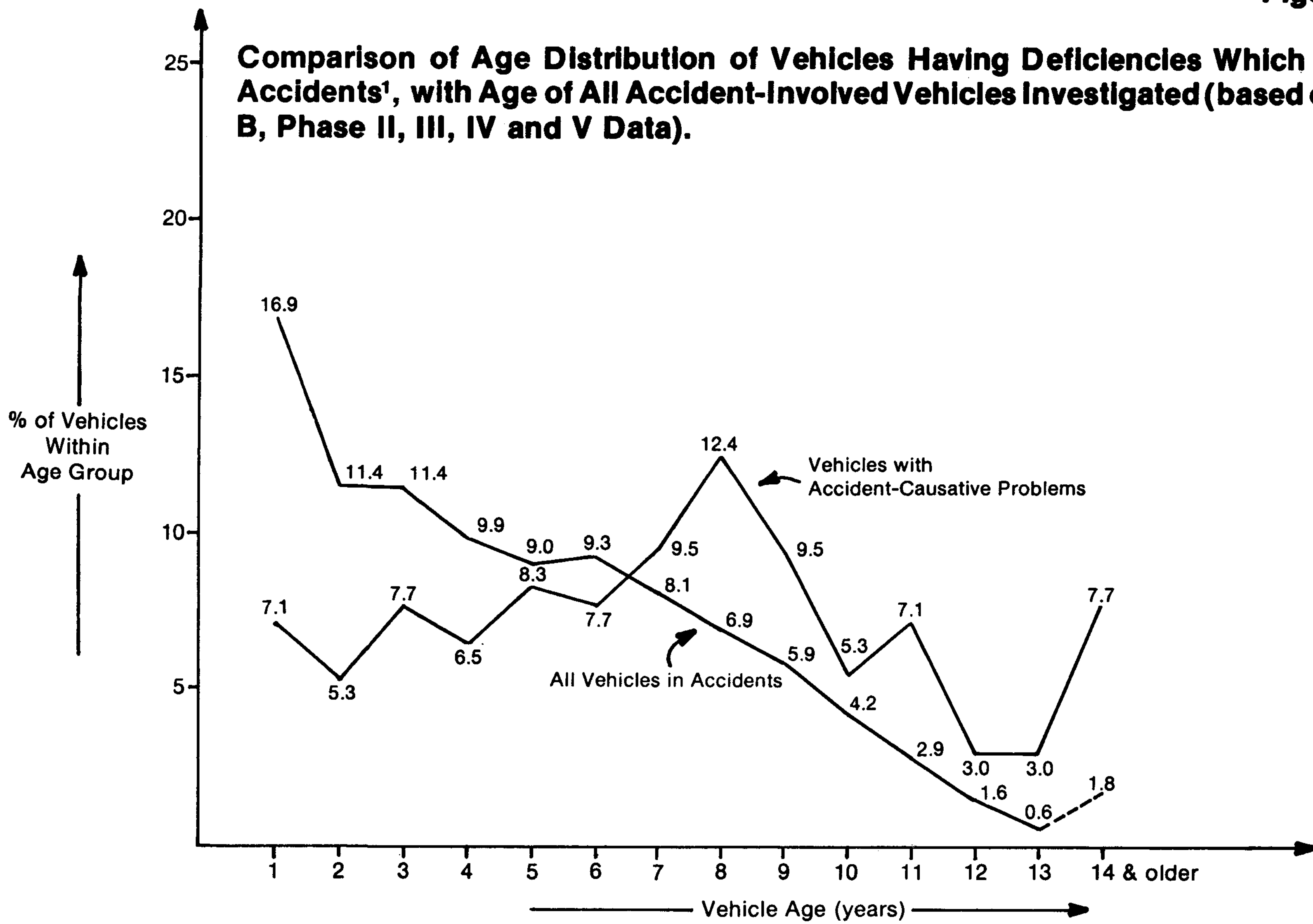
IN-DEPTH DATA

Age Groups	Vehicles Involved Due to Vehicle Problems N	%	All Other Accident Vehicles N	%	Involvement Ratio	Total Accident Vehicles N	%
1-3 yrs.	9	18.0	224	39.1	.46	233	37.4
4-7 yrs.	17	34.0	218	38.0	.89	235	37.7
8 & older yrs.	24	48.0	131	22.9	2.1	155	24.9
Totals	50	100.0	573	100.0	—	623	100.0

$\bar{X}^2 = 17.35$ $p \leq .001$

Figure 3-13

Comparison of Age Distribution of Vehicles Having Deficiencies Which Caused Accidents[1], with Age of All Accident-Involved Vehicles Investigated (based on Level B, Phase II, III, IV and V Data).



[1] "Caused" means that these were accidents in which, for the vehicle in question, vehicular factors were "certain or probable, causal or severity-increasing" factors.

4.0 Trend Analysis of Causal Results Across Phases II, III, IV, and V

4.1 Introduction

Causal results have been tabulated using essentially the same assessment system across Phases II, III, IV, and V. The same causal factors were also used in Phase I, but with different nomenclature; in Phase I, causes were designated as being either prime or contributing (rather than certain, probable, or possible and causal or severity-increasing). The intention of this section is to identify statistically significant changes across the latter four phases for which direct comparison of percentage results is possible. Chi-square tests were employed for this purpose. Results are summarized in Tables 4-1 to 4-5; these tables also provide indications of large changes in relative frequencies across phases, regardless of statistical significance. Note that the trend analysis and related discussions are based solely on the "probable-level results" (i.e., those extracted from the "certain or probable, causal or severity-increasing" cell of the detailed data tables).

4.2 Results and Discussion

The trend analysis shows that the relative frequencies for the overall human causal factors category have tended to decrease significantly across phases in the in-depth data. On-site results also vary significantly, but in a different manner from in-depth. Like the in-depth results, they decreased steadily across Phases III, IV, and V; but unlike in-depth, increased between Phases II and III. Environmental factors have tended to significantly decrease across phases in the on-site data (but not in-depth), while vehicle factor results have varied significantly across phases in both on-site and in-depth data, but not necessarily in the same direction. In other words, considering both on-site and in-depth results, there is no unambiguous trend apparent across time with respect to the relative contribution of human, vehicular, and environmental factors in causing traffic accidents.

Top-Level Results (Table 4-1)

Table 4-1 shows that both **human factor results overall** and **human direct cause results** varied significantly for the in-depth data; this trend was in the direction of decreasing relative frequency. Actually, in-depth team results remained at about the same level in Phases II and III, but then decreased progressively across the final three phases. On-site results for human factors overall also varied significantly, although the trend is of mixed character, with an increase between Phases II and III, followed by a steady decrease across the latter three phases. Note that in-depth results also decreased steadily across these final three phases. The trend for human direct causes in the on-site data is not significant.

With respect to **environmental data,** both including and excluding the "slick roads"

Table 4-1

Summary of Trends in Causal Results Across Phases II, III, IV, V (based on Probable Level Results)

Causal Factors	On-Site				In-Depth				Direction of Change	
	Sig.	x^2	Probable Level Results-Phases II-III-IV-V (in percent)	Max. Diff. (√ =5-10%) (√√=11-15%) (√√√=16-20%)	Sig.	x^2	Probable Level Results-Phases II-III-IV-V (in percent)	Max. Diff. (√ =5-10%) (√√=11-15%) (√√√=16-20%)	OS	ID
• Human—Overall	*	10.55	91-94-92-88	√	***	17.21	97-97-91-84	√√	M	D
• Human—Direct Causes	NS	5.57	88-90-90-86		**	15.43	97-97-91-84	√√	—	D
• Human—Conditions & States	***	31.30	19-16-8-12	√√	NS	3.81	14-14-15-7	√	M	(D)
• Environmental—Including Slick Roads	***	30.93	42-42-33-29	√√	NS	2.41	33-31-40-30	√	D	(M)
• Environmental—Excluding Slick Roads	***	31.02	30-31-21-20	√	NS	2.23	27-23-31-23	√	D	(M)
• Vehicular	***	26.21	14-9-10-6	√	*	9.38	18-3-11-13	√	D	M

* $p \leq .05$
** $p \leq .01$
*** $p \leq .001$
NS = Not Significant

U = Upward trend
D = Downward trend
M = Mixed trend
( ) = Indicates statistically Non-significant change

category, Table 4-1 shows a significant downward trend in the on-site data, which results primarily from the rather sharp drop in relative frequencies between Phases III and IV. The in-depth trends for these environmental categories were not significant, and it is interesting to note that at the same time on-site results dropped (between Phases III and IV), in-depth results for these categories increased.

Results for **vehicular factors** are perhaps hardest to reconcile. For vehicular factors, Table 4-1 indicates that both on-site and in-depth trends are significant, but are decidedly different from each other. In both on-site and in-depth data, results for vehicular factors overall in the latter three phases (which constituted the Tri-Level Causation Study) are lower than results recorded in Phase II (during the Vehicle Defects Project). Within the latter three phases, however, on-site results first increased slightly (in Phase IV), and then decreased by four percentage points (from 10% in Phase IV to 6% in Phase V), while in-depth results increased by ten percentage points (from 3% in Phase III to 13% in Phase V). Until Phase V, on-site and in-depth results had tended to move in the same direction (i.e., both decreased from Phase II to III, and then increased somewhat between Phases III and IV). In Phase V, however, results moved in opposite directions, with on-site results dropping from 10% to 6%, while in-depth results increased from 11% to 13%.

In the absence of clearly defined trends substantiated in both the on-site and in-depth data, interpretation of these top-level category trends is obviously difficult. The in-depth results are generally regarded as the most accurate, and these certainly support the idea of decreasing involvement of human causal factors in accidents. Relative frequencies progressed steadily downward from 97% in Phases II and III to 84% in Phase V (probable level results). This quite possibly reflects a real decrease. Detracting from this, however, are the on-site results. These were 88% in Phase V (lowest recorded in any phase), but only three percentage points below the 91% recorded for Phase II, begun three years previously.

The situation is equally unclear for environmental factors. While on-site environmental results have decreased, in-depth results have remained at about the same level, detracting from the idea that any real decrease has occurred. Again, given the assumed greater accuracy of the in-depth data, it is doubtful that any large or noteworthy change in the actual contribution of environmental factors has occurred.

The situation for vehicular factors is particularly uncertain. It may be generalized that both on-site and in-depth results during the final three phases (Tri-Level Study) were lower than in Phase II (Vehicle Defects Study), possibly reflecting a decrease in involvement for vehicular factors. Certainly, given continuing efforts to improve the State's periodic motor vehicle inspection program, plus the increasing proportion of cars with significant safety improvements (such as dual-chamber master cylinder braking systems), it would not be surprising if a decrease in the relative contribution of vehicular factors had occurred.

In summary, the following are the major overall changes in top level results, according to Table 4-1:

- Results for human factors overall and for human direct causes have significantly decreased in the in-depth data.

- Environmental causation results, both including and excluding "slick roads," have significantly decreased across phases in the on-site data.
- Results for vehicular factors have varied significantly, both on-site and in-depth, but not always in the same direction.

Note that there appears to be a tendency for each of the major causal factor groups — human, vehicular, and environmental — to have decreased. This might at first seem impossible, but actually reflects a decrease in the frequency with which more than one type of causal factor is cited. For example, the combination of human and environmental factors was cited as a cause in the same accident considerably less frequently in Phase V than in previous phases (both on-site and in-depth).

Review of Other Significant Trends

For only one causal factor category at any level of detail (and whether human, vehicular, or environmental) was there a significant and progressive change in the same direction in both on-site and in-depth data, and this was for the **decision errors category,** which has consistently decreased in both sets of data (see Table 4-2). This would certainly be the most unambiguous evidence of a potentially real and important trend. If valid, this would indicate that the problem of drivers making incorrect decisions was less frequently involved as a cause as time went on. This in turn could be a function of drivers possibly being better educated and equipped to make proper decisions or, equally, being faced with an increasingly forgiving and well-designated environment in which to drive. Still another potential explanation could be that improved vehicles have provided an added margin of error, reducing the criticality of quick decision-making. For example, it is possible that side marker lights and radial tires may have reduced the criticality of, or need for, quick decision-making by drivers. It should be understood that these are merely possible explanations, rather than conclusions based on study data. Of course the trend could also be an artifact of changing assessment practices, or characteristics of accidents investigated.

While the reasons for the downward trend in decision errors are not entirely clear, a major component of the decrease in the on-site data is **decreases in the false assumption** and **improper evasive action** categories. False assumption shows significant trends in both on-site and in-depth data. In the on-site data, this reflects a drop between Phases II and III, although results have been virtually unchanged across the latter three phases. The in-depth results for this factor show an increase between Phases II and III, but progressive decreases during the final three, with a particularly notable drop between Phase IV and Phase V. Reasons for the sharp drop in Phase V are not known, although this phase coincides with the beginning of an experimental psychologist's participation in the project as a team leader. It is entirely possible that as he assumed this role, new ideas were introduced as to what was appropriately called a

Table 4-2

Trends in Human Direct Cause Results Across Phases II, III, IV, V (based on Probable Level Results)

Causal Factors	On-Site				In-Depth				Direction of Change	
	Sig.	x^2	Probable Level Results-Phases II-III-IV-V (in percent)	Max. Diff. (√ =5-10%) (√√=11-15%) (√√√=16-20%)	Sig.	x^2	Probable Level Results-Phases II-III-IV-V (in percent)	Max. Diff. (√ =5-10%) (√√ =11-15%) (√√√=16-20%)	OS	ID
Human Factors—Direct Causes	NS	5.57	88-90-90-86		**	15.43	97-97-91-84	√√	—	D
1. Critical Non-Perf.	NS	1.55	1-1-2-1		NS	3.71	1-0-3-4		—	—
a. Blackout	NS	1.92	1-1-1-1		NS	1.46	1-0-0-1		—	—
b. Dozing	NS	7.82	0-0-1-1		NS	4.00	1-0-3-3		—	—
2. Non-Accident (e.g., suicide)	NS	0.00	0-0-0-0		NS	0.00	0-0-0-0		—	—
3. Recognition Errors	NS	7.20	52-57-52-48	√	NS	3.57	60-58-57-48	√√	(M)	(D)
a. Driver Failed to Observe Stop Sign	NS	1.94	5-4-4-5		NS	4.51	10-3-6-5	√	—	(M)
b. Delays in Recognition—Reasons Identified	***	17.65	46-51-45-39	√	NS	6.37	50-53-52-37	√√√	M	(D)
(1) Inattention	***	44.72	21-18-12-9	√√	NS	6.41	19-20-13-9	√	D	(D)
(2) Internal Distraction	NS	3.37	5-5-8-6		NS	3.04	7-11-13-7	√	—	(M)
(3) External Distraction	*	8.53	3-7-6-5		NS	1.70	3-5-6-5		M	—
(4) Improper Lookout	NS	4.19	20-25-20-19	√	NS	1.60	25-23-24-19		(M)	—
c. Delays in Perception for Other or Unknown Reasons	NS	6.49	3-6-5-6		*	7.87	10-3-3-11	√	—	M
d. Delays in Comprehension or Reaction—Other or Unknown	NS	5.09	2-1-1-1		NS	3.58	1-0-0-0		—	—
4. Decision Errors	***	39.93	57-54-46-41	√√√	**	13.74	63-53-48-40	√√√	D	D
a. Misjudgment	NS	1.45	2-3-3-2		NS	1.73	3-5-5-6		—	—
b. False Assumption	***	16.48	17-10-10-10	√	*	8.93	9-14-11-2	√√	D	M
c. Improper Maneuver	NS	2.28	8-8-6-7		*	10.51	11-3-4-3	√	—	D
d. Improper Driving Technique	***	30.89	6-8-2-3	√	*	9.17	13-2-11-6	√√	M	M
e. Driving Technique was Inadequately Defensive	**	12.10	3-7-7-5		NS	5.82	9-16-8-5	√√	M	(M)
f. Excessive Speed	NS	5.44	16-17-15-13		NS	4.25	22-16-14-14	√	—	(D)
g. Tailgating	***	24.86	3-2-0-0		NS	4.77	3-0-1-0		D	—
h. Inadequate Signal	*	9.11	2-2-2-0		NS	3.97	3-6-3-1	√	D	(D)
i. Failure to Turn on Headlights	NS	3.53	0-0-0-0		NS	1.79	1-0-0-0		—	—
j. Excessive Acceleration	NS	2.90	0-1-0-1		NS	4.71	0-2-0-2		—	—
k. Pedestrian Ran into Traffic	**	12.26	1-1-0-0		NS	5.38	2-0-0-0		D	—
l. Improper Evasive Action	***	25.10	16-11-10-7	√	***	17.26	23-8-8-9	√√	D	D
5. Performance Errors	*	10.05	7-7-11-11		NS	1.65	13-13-8-12	√	U	(M)
a. Overcompensation	NS	5.36	2-3-5-3		NS	7.77	5-11-2-9	√	—	(M)
b. Panic or Freezing	NS	6.47	3-1-2-1		NS	5.58	0-2-0-0		—	—
c. Inadequate Directional Control	***	37.04	1-1-5-7	√	NS	4.60	7-3-4-2	√	U	(D)
d. Other Performance Errors	NS	7.55	1-2-1-0		NS	1.34	1-0-2-2		—	—

* $p \leq .05$
** $p \leq .01$
*** $p \leq .001$
NS = Not Significant

U = Upward trend
D = Downward trend
M = Mixed trend
( ) = Indicates statistically Non-significant change

false assumption, possibly contributing to an increase in results for other categories. Similarly, decreases for "inattention" could have led to increases in the in-depth data for "delays in perception for other or unknown reasons." In other words, given a high level of confidence that a perceptual delay or problem has occurred, there is some room for discretion within the assessment system to either specify a specific reason for the delay (such as inattention), or to take the more conservative route of designating it simply a "delay in perception for other or unknown reasons." Equally, decreases in the false assumption category could reflect improvements in drivers, such as might result, for example, through driver education programs. Each year an increasing proportion of drivers on the road have had driver education.

As mentioned above, the downward trend for decision errors is further accounted for, in part, by decreases in the improper evasive action category, which has decreased significantly in both on-site and in-depth data. There has been a steady, progressive decrease across phases in the on-site data, while in the in-depth data there has been a very marked decrease between Phases II and III, followed by no change across the latter three phases. The sharp drop between Phases II and III, from 23% to 8% (probable level results), is so great as to suggest variance from either sampling or assessment practices. This sharp drop is even evident in the in-depth team's "possible cause" data, which went from 32% in Phase II to 11% in Phase III (in-depth). And, while in-depth probable level results have been constant across Phases III, IV, and V, the possible cause results have increased (11%, 19%, and 20%). On-site possible cause results for improper evasive action across these four phases are 20%, 13%, 12%, and 10%.

In summary, in addition to the human factors overall category, significant trends in generally decreasing directions, both in the on-site and in-depth data, were noted for the following:

- decision errors, which showed consistent progressive decreases, both on-site and in-depth;
- improper evasive action, although in-depth results were actually fairly steady across the final three phases (III, IV, and V); and
- false assumption, for which in-depth results dropped sharply in Phase V, although on-site results were actually about the same across the final three phases.

For only one category were there significant trends, both on-site and in-depth, in essentially opposite directions, and that was the **vehicle factors category.** Even so, changes were in the same direction from phase to phase, except between the last two phases, where in-depth increased and on-site decreased.

For only two categories were there significant trends (either on-site or in-depth), which were essentially in the direction of increasing relative frequency. These were:

- performance errors, which showed significant increases in the on-site data; and

- inadequate directional control, which also showed a significant increase on-site.

While the absence of a clear increase in the in-depth data for the above factors puts their validity in question, to the extent that an actual increase in the role of these factors is indicated, the need may also be indicated for increasing emphasis on driver skill training, and perhaps the "behind the wheel" aspect of driver education.

Summary of Significant Changes Among The Most Frequently Implicated Causal Factors

Of the ten most frequently identified specific causal factors, significant trends were identified either on-site or in-depth for five factors. These were:

- inattention, which showed a significant downward trend in the on-site data;
- improper evasive action, which showed significant downward trends, both on-site and in-depth;
- false assumption, which showed a significant downward trend on-site, and a mixed trend in-depth (but with a considerable decrease in Phase V);
- improper driving technique, which showed significant trends of mixed character, both on-site and in-depth; and
- inadequate defensive driving technique, for which there was a mixed trend on-site.

It should be noted that for the two highest-ranking human factors (improper lookout and excessive speed), the two most frequent environmental causes (view obstructions and slick roads), and the most frequent vehicular accident cause (brake system problems), significant trends did not occur in either on-site or in-depth data. In other words, if one concentrates only on the specific causal factors showing the highest relative frequency, it appears that things have changed very little across the four phases (and this holds true in both the on-site and in-depth data). Thus, despite whatever variations in team makeup and assessment practices may have occurred, the identification of the most frequently cited factors (and even the extent of their involvement) has not changed significantly.

With respect to the second-ranking vehicular factor (tires and wheels), a significant downward trend is evident in the on-site data. While in-depth results are particularly looked to for accuracy where the more subtle vehicular factors are concerned, this nevertheless raises the possibility of an actual change of interest. Since the proportion of wet- and dry-road accidents has not changed radically and inspection data does not show major improvement in the condition of accident-vehicle tires, other explanations must be sought. Among these is the possibility that the increasing quality of tires and the introduction of radial tires may have played a positive role in bringing about the decrease. On the other hand, changes in assessment practices and accident character could also be responsible. On-site investigators could have become more conservative in determining that tires with low tread depth or those which are underinflated are causally involved. It is indicative that in-depth results show no such trend for tires and wheels (with probable level results across the four phases of 5%, 2%, 3%, and 5%).

Explanation of Overall Decrease

It may be noted that most of the significant trends appear to be in the direction of decreasing relative frequency. Since the approach used assumes that each accident may have a number of causes, this decrease suggests a tendency to broaden the range of factors cited; that is, to initially cite certain categories with great frequency, and then as time goes by to use them less, citing new (formerly little-used) categories instead. If this is true, it reflects changes in assessment practices rather than overall changes in the character of accidents. While undesirable, this type of change would not be as detrimental as it might at first seem. For example, note that in Phase V the in-depth team has tended to increase its assignment to the category "delays in perception for other or unknown reasons." This produced a significant trend in the in-depth data, with probable level results across the four phases of 10%, 3%, 3%, and 11% (see Table 4-2). This increase (from Phases III and IV to Phase V) necessarily is a part of the explanation for the simultaneous decrease in the category "delay in recognition — reasons identified." Between these, decisions as to which factor should be tallied may be difficult. Given that the investigation team is confident that a delay in recognition or perception has occurred and is causally relevant, final placement is sensitive to whether the investigation team's understanding of category definitions justifies placement within one of the "delays in recognition — reasons identified" categories. The investigation team may opt instead to tally it simply as a "delay for other or unknown reasons," rather than to label it, for example, a delay on account of a "inattention." The decision clearly has no influence on the overall "recognition errors" statistic, nor for that matter on the relative frequency for human factors overall, but does influence the relative frequencies at lower levels within the causal hierarchy.

Table 4-3

Trends in Human Condition and State Results Across Phases II, III, IV, V (based on Probable Level Results)

Causal Factors	On-Site				In-Depth				Direction of Change	
	Sig.	x^2	Probable Level Results-Phases II-III-IV-V (in percent)	Max. Diff. (√ =5-10%) (√√=11-15%) (√√√=16-20%)	Sig.	x^2	Probable Level Results-Phases II-III-IV-V (in percent)	Max. Diff. (√ =5-10%) (√√=11-15%) (√√√=16-20%)	OS	ID
Human—Conditions & States	***	31.30	19-16-8-12	√√	NS	3.81	14-14-15-7	√	M	(D)
Physical/Physiological	NS	3.84	8-8-5-8		NS	1.85	8-6-8-4		—	—
1. Alcohol-Impairment	NS	4.01	6-5-5-7		NS	3.96	3-6-4-1	√	—	(M)
2. Other Drug Impairment	NS	4.79	1-1-0-0		NS	6.34	4-0-3-0		—	—
3. Fatigue	NS	2.79	1-0-0-0		NS	5.16	1-0-4-2		—	—
4. Physical Handicap	NS	6.38	0-0-0-0		NS	0.00	0-0-0-0		—	—
5. Reduced Vision	NS	4.04	1-0-0-0		NS	1.46	1-0-0-1		—	—
6. Chronic Illness	NS	3.82	0-0-0-0		NS	0.00	0-0-0-0		—	—
Mental/Emotional	*	9.05	2-4-1-2		NS	3.34	5-3-2-1		M	—
1. Emotionally Upset	NS	1.73	1-1-0-1		NS	4.77	3-0-1-0		—	—
2. Pressure from Other Drivers	NS	5.52	0-1-0-0		NS	2.92	1-2-0-0		—	—
3. "In-Hurry"	NS	6.60	1-2-0-1		NS	.97	1-2-2-1		—	—
4. Mental Deficiency	NS	0.00	0-0-0-0		NS	0.00	0-0-0-0		—	—
Experience/Exposure	***	50.00	10-6-2-3	√	NS	3.83	1-5-5-2		D	—
1 Driver Inexperience	***	21.66	3-1-0-1		NS	2.39	1-2-3-1		M	—
2. Vehicle Unfamiliarity	NS	6.56	2-0-0-1		NS[1]	11.57	1-5-0-0	√	—	M
3. Road Over-Familiarity	NS	3.11	1-1-1-0		NS	0.00	0-0-0-0		—	—
4. Road/Area Unfamiliarity	***	28.39	5-4-1-1		NS	3.84	0-0-2-1		D	—

* $p \leq .05$
** $p \leq .01$
*** $p \leq .001$
NS [illegible]nificant

[1] [illegible] Exact Test after combining Phases II, III and IV, V.

U = Upward trend
D = Downward trend
M = Mixed trend
( ) = Indicates statistically Non-significant change

Table 4-4

Trends in Environmental Causal Results Across Phases II, III, IV, V (based on Probable Level Results)

Causal Factors	On-Site				In-Depth				Direction of Change	
	Sig.	x^2	Probable Level Results-Phases II-III-IV-V (in percent)	Max. Diff. (√ =5–10%) (√√ =11–15%) (√√√=16–20%)	Sig.	x^2	Probable Level Results-Phases II-III-IV-V (in percent)	Max. Diff. (√ =5–10%) (√√ =11–15%) (√√√=16–20%)	OS	ID
Environmental Factors—Including Slick Roads	***	30.93	42-42-33-29	√	NS	2.41	33-31-40-30	√	D	(M)
1. Slick Roads	NS	5.79	17-14-15-12		NS	1.08	8-11-12-10		—	—
Environmental Factors—Excluding Slick Roads	***	31.02	30-31-21-20	√	NS	2.23	27-23-31-23	√	D	(M)
1. Highway-Related	***	31.80	24-23-14-14	√√	NS	.49	21-22-22-19		D	—
a. Control Hindrances	NS	11.80	5-4-2-2		NS	3.34	5-2-2-6		—	—
b. Inadequate Signs & Signals	***	17.07	4-6-2-2		NS	4.38	3-6-1-2	√	M	(M)
c. View Obstructions	NS	5.64	13-13-10-10		NS	1.75	11-13-16-10	√	—	(M)
d. Design Problems	***	26.12	4-4-1-1		NS	3.56	6-3-7-2	√	D	(M)
e. Maintenance Problems	NS	5.08	1-1-0-0		NS	3.13	0-0-0-1		—	—
2. Ambience-Related	NS	5.21	7-10-9-7		NS	1.68	6-6-10-6		—	—
a. Special Hazards	NS	5.83	4-8-6-5		NS	2.61	3-6-8-5	√	—	(M)
b. Ambient Vision Limitations	NS	1.28	1-2-1-1		NS	.66	1-0-1-1		—	—
c. Avoidance Obstructions	NS[1]	13.52	1-0-2-0		NS	3.39	1-0-2-0		M	—
d. Rapid Weather Change	NS	1.53	0-0-0-0		NS	0.00	0-0-0-0		—	—
e. Camouflage Effect	NS	2.83	0-0-0-0		NS	0.00	0-0-0-0		—	—
f. Environmental Overload	NS	1.53	0-0-0-0		NS	0.00	0-0-0-0		—	—

* $p \leq .05$
** $p \leq .01$
*** $p \leq .001$
NS = Not Significant

[1] Results of Fisher Exact Test after combining Phases II, III and IV, V.

U = Upward trend
D = Downward trend
M = Mixed trend
( ) = Indicates statistically Non-significant change

Table 4-5

Trends in Vehicular Causal Results Across Phases II, III, IV, V (based on Probable Level Results)

Causal Factors	On-Site				In-Depth				Direction of Change	
	Sig.	x^2	Probable Level Results-Phases II-III-IV-V (in percent)	Max. Diff. (√ =5-10%) (√√ =11-15%) (√√√=16-20%)	Sig.	x^2	Probable Level Results-Phases II-III-IV-V (in percent)	Max. Diff. (√ =5-10%) (√√ =11-15%) (√√√=16-20%)	OS	ID
Vehicular Factors	***	26.21	14-9-10-6	√	*	9.38	18-3-11-13	√√	D	M
1. Tires and Wheels	**	15.59	4-3-2-1		NS	2.16	5-2-3-5		D	—
2. Brake System	NS	6.31	3-3-4-2		NS	3.44	7-2-6-4	√	—	(M)
3. Steering System	NS	6.30	2-2-1-1		NS	3.94	2-2-0-0		—	—
4. Suspension Problems	NS	6.12	0-0-1-0		NS	3.13	0-0-0-1		—	—
5. Power Train & Exhaust	NS	1.12	1-0-0-0		NS	3.09	0-0-1-0		—	—
6. Communication Systems	NS	3.10	3-2-3-2		NS	1.28	2-0-2-2		—	—
7. Driver Seating & Controls	NS	.69	0-0-0-0		NS	3.13	0-0-0-1		—	—
8. Body & Doors	NS	6.53	0-0-0-0		NS	5.38	2-0-0-0		—	—
9. Other	*	10.70	2-0-0-0		NS	0.00	0-0-0-0		D	—

* $p \leq .05$
** $p \leq .01$
*** $p \leq .001$
NS = Not Significant

U = Upward trend
D = Downward trend
M = Mixed trend
( ) = Indicates statistically Non-significant change

5.0 Analysis of Accident Severity as a Function of Accident Causation

5.1 Introduction

In Interim Report I, Volume I of the present study (section 3.6), an analysis of accident severity as a function of causal factors was conducted, based on Phase II and III data. The present section updates the earlier analysis, and is based on cumulative Phases II, III, IV, and V data, providing 2,258 accidents investigated on-site, and 420 in-depth. Results of this and the earlier analysis are generally similar, with alcohol-impairment again emerging as being associated with greater severity, both on-site and in-depth.

Overall, the in-depth sample was comprised of 69.1 percent property damage accidents (PD) and 30.9 percent personal injury or fatal accidents (PI/F). The on-site sample was 73.8 percent PD, and 26.2 percent PI/F. Tests for differences in PI/F proportions were run for both on-site and in-depth samples. Two-sample chi-square tests were used to determine the statistical significance of the PI/F percentage difference between the sample of accidents with a particular type of causal involvement and the sample of accidents in which that same causal factor was not implicated. Of the 304 total comparisons (one for each causal factor) for each sample (on-site and in-depth), only 34 were found to be statistically significant; the in-depth sample accounted for only 8 of these (Table 5-1).

5.2 Results and Discussion

The following discussion draws on the major factors from an intermediate level in the hierarchy, rather than the more detailed subcategories.

In the on-site data, four factors were found to significantly overrepresent the personal injury/fatality type accident. In the order of greatest overrepresentation, these were:

- Alcohol Impairment (53.1% PI/F)
- Control Hindrances (43.9% PI/F)
- Excessive Speed (42.4% PI/F)
- Tires and Wheels (41.9% PI/F)

These results compare with an overall breakdown for on-site accidents of only 26.2% PI/F and 73.8% PD only.

In the in-depth data only two factors were significantly more serious (in overrepresenting the personal injury/fatality class), and these were two of the same factors identified on-site: (1) **Alcohol Impairment** (84.6% PI/F), and (2) **Excessive Speed** (44.9% PI/F). Overall, only 30.9% of in-depth accidents were PI/F, while 70.1% were PD only.

The fact that accidents resulting from excessive speed tend to be more serious is an intuitively expected result; on-site and in-depth data are in close agreement as to the degree of overrepresentation.

The result for alcohol impairment, however, was not so easily foreseen. While both on-site and in-depth teams agreed on the significantly greater seriousness, they differed as to the

Table 5-1

Comparison of Accident Severity for Crashes Resulting From Different Causal Factors (With Shading Indicating Percentages Larger than Expected)

Causal Factor	Level of Investigation	Property Damage		Personal Injury, Fatality		Chi-Square
		n	%	n	%	
Human Factors	C	256	69.6	112	30.4	χ^2=0.25 NS
	B	1432	74.5	490	25.5	χ^2=4.70*
Human Factors (Direct Causes)	C	256	69.8	111	30.2	χ^2=0.62 NS
	B	1403	75.0	468	25.0	χ^2=10.77***
Recognition Errors	C	161	73.2	59	26.7	χ^2=3.32 NS
	B	864	79.6	221	20.4	χ^2=38.28***
Delays in Recognition	C	136	72.7	51	27.3	χ^2=1.86 NS
	B	746	80.3	183	19.7	χ^2=35.41***
Inattention	C	41	69.5	18	30.5	χ^2=0.01 NS
	B	231	79.1	61	20.9	χ^2=4.61*
Inattention—Due to Traffic Stopped or Slowing	C	16	80.0	4	20.0	χ^2=0.69 NS
	B	124	83.8	24	11.2	χ^2=7.64**
Internal Distraction—Event in Car, Loud Noise, etc.	C	4	57.1	3	42.9	χ^2=0.08 NS
	B	19	55.9	15	44.1	χ^2=4.84*
External Distraction	C	13	86.7	2	13.3	χ^2=1.48 NS
	B	89	84.0	17	16.0	χ^2=5.41*
Improper Lookout	C	73	80.2	18	19.8	χ^2=6.17*
	B	366	83.4	73	16.6	χ^2=25.55***
Improper Lookout—Pulling Out From Parking Place	C	4	80.0	1	20.0	χ^2=0.00 NS
	B	35	92.1	3	7.9	χ^2=5.77*
Improper Lookout—Entering Travel Lane from Alley or Intersecting Street	C	53	77.9	15	22.1	χ^2=2.52 NS
	B	214	80.1	53	19.9	χ^2=5.98*
Improper Lookout—Prior to Changing Lanes	C	8	100.0	0	0.0	F.E.P.=0.050 NS
	B	57	91.9	5	8.1	χ^2=9.91**
False Assumption	C	26	74.3	9	25.7	χ^2=0.25 NS
	B	222	85.1	39	14.9	χ^2=18.82***

Table 5-1 continued

False Assumption—Other	C	12	80.0	3	20.0	χ^2=0.41 NS
	B	76	90.5	8	9.5	χ^2=11.68***
Improper Maneuver—Turning from Wrong Lane	C	7	87.5	1	12.5	χ^2=0.56 NS
	B	56	91.8	5	8.2	χ^2=9.58**
Excessive Speed	C	38	55.1	31	44.9	χ^2=6.95**
	B	175	57.6	129	42.4	χ^2=47.46***
Excessive Speed—For Road Design	C	22	52.4	20	47.6	χ^2=5.32*
	B	94	54.7	78	45.3	χ^2=34.47***
Excessive Speed—In Light of Traffic Density	C	0	0.0	4	100.0	F.E.P.= .009**
	B	25	64.1	14	35.9	χ^2=1.46 NS
Excessive Speed—Due to Combinations of Factors	C	6	75.0	2	25.0	χ^2=0.00 NS
	B	26	56.5	20	43.4	χ^2=6.39*
Pedestrian Ran into Traffic	C	0	0.0	3	100.0	F.E.P.= .029*
	B	0	0.0	7	100.0	F.E.P.= .000***
Performance Errors	C	28	63.6	16	36.4	χ^2=0.44 NS
	B	117	59.7	79	40.3	χ^2=21.46***
Inadequate Directional Control	C	10	58.8	7	5.7	χ^2=0.45 NS
	B	46	52.3	42	49.7	χ^2=20.88***
Human Conditions or States	C	32	62.7	19	37.3	χ^2=0.80 NS
	B	169	60.4	111	39.6	χ^2=29.40***
Physical/Physiological	C	13	46.4	15	53.6	χ^2=6.17*
	B	78	50.6	76	49.4	χ^2=44.80***
Alcohol Impairment	C	2	15.4	11	84.6	χ^2=15.67***
	B	60	46.9	68	53.1	χ^2=49.65***
Other Drug Impairment	C	5	55.6	4	44.4	χ^2=0.28 NS
	B	6	46.2	7	53.8	F.E.P.= .031*
Environmental Factors—Road Snow and/or Ice Covered	C	12	85.7	2	14.3	χ^2=1.15 NS
	B	64	86.5	10	13.4	χ^2=5.71*
Control Hindrances	C	7	53.8	6	46.1	χ^2=0.82 NS
	B	32	56.1	25	43.9	χ^2=8.55**
Drop-Off at Pavement Edge	C	3	60.0	2	40.0	χ^2=0.00 NS
	B	11	45.5	12	54.5	χ^2=7.82**

Table 5-1 continued

Other Control Hindrances	C	2	50.0	2	50.0	χ^2 =0.08 NS
	B	1	14.3	6	85.7	χ^2 =9.97**
View Obstructions— Parked Traffic	C	10	71.4	4	28.6	χ^2 =0.01 NS
	B	52	86.7	8	13.3	χ^2 =4.62*
Design Problems—Road Overly Twisting, Narrow, etc.	C	8	66.7	4	33.3	χ^2 =0.02 NS
	B	8	38.1	13	61.9	χ^2 =12.19***
Vehicle Factors— Tires and Wheels	C	12	80.0	3	20.0	χ^2 =0.42 NS
	B	25	58.1	18	41.9	χ^2 =4.78*
Vehicle Factors—Body and Doors	C	0	0.0	3	100.0	F.E.P.=0.029*
	B	0	0.0	2	100.0	F.E.P.=0.068 NS

F.E.P.—Fisher Exact Probability
NS —Not Significant
* $p \leq .05$
** $p \leq .01$
*** $p \leq .001$

degree. Of accidents resulting from alcohol impairment, in-depth recorded nearly 85% as being PI/F, while only 53.1% of on-site were of this class. Reasons for the difference are not known, but could be related to problems of acquiring cooperation for an in-depth investigation from some impaired drivers.

Control hindrances are comprised primarily of pavement edge drop-offs, so that results reflect the relative seriousness of having an accident because of this type of problem. Although not significant, in-depth results also showed control hindrance accidents as tending to be more serious; 46.2% of these in-depth accidents were PI/F.

The tires and wheels category is comprised primarily of inadequate tread depth and underinflation—factors which, like excessive speed and control hindrances, are often associated with a "loss of control." Blow-outs and wheel loss or failure have been rarely identified. The greater seriousness of even non-catastrophic tire and wheel degradations is thus indicated by the on-site data. However, the in-depth data, which should be the best authority for assessing such subtleties as the influence of degraded tires on handling, does not support this finding. In-depth accidents resulting from tires and wheels tended to involve only property damage, although this result was not significant.

Three factors were found to be associated with a significant overrepresentation of **PD accidents** in the on-site data. These factors were:

- False Assumption (85.1% PD only)

- External Distraction (84.0% PD only)
- Improper Lookout (83.4% PD only)

Note that these are all human direct cause factors, and are also causes which tend to be associated with collisions with other vehicles rather than running off the road. One of these—improper lookout— is the single most frequently identified causal factor in the study, and tends to involve a failure to either look for or see on-coming traffic (from right angles) at intersections.

In the in-depth data, no factor significantly overrepresented the (less severe) property damage class of accidents. However, each of the factors identified on-site (false assumption, external distraction, and improper lookout), also tended to involve more property damage accidents than expected, in the in-depth data.

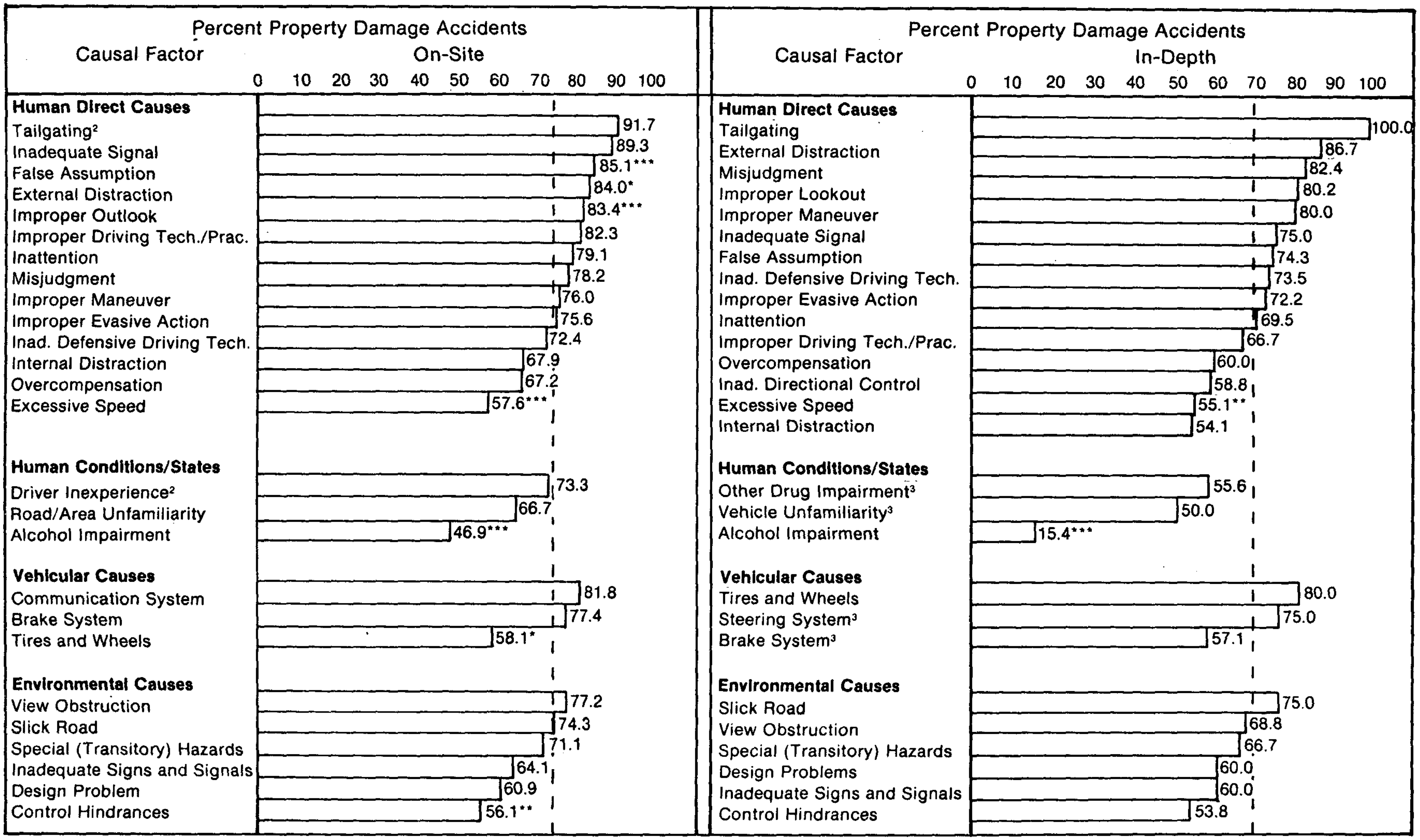
In summary, based on the present analysis, only two factors were identified for which statistically significant differences of severity occurred in both on-site and in-depth data. These were excessive speed (a human direct cause) and alcohol-impairment (a human condition or state). Accidents resulting from these factors more frequently involved a personal injury or fatality than would have been expected.

The results are quite similar to those recorded earlier in Interim Report I. All of the factors significant in the on-site data had been significant in the previous analysis, with the exception of tires and wheels. In Interim Report I, accidents resulting from tire and wheel problems were 32% PI/F, compared to 27% PI/F for the overall sample. With the additional accidents, this margin increased and became significant.

In-depth results were also the same as before, except that with additional cases, the tendency for excessive speed to be associated with greater severity has become statistically significant.

Figure 5-1

Percent Property Damage Accidents for "Frequently Occurring"[1] Causal Factors in Phase II, III, IV and V Investigations



[1] In-Depth factors occurring four or more times in Phases II and III. On-Site factors occurring sixteen or more times in Phases II and III.
[2] $N < 40$ on On-Site level.
[3] $N < 10$ on In-Depth level.
[4] Overall percentage of property damage accidents in Phases II, III, IV, V on-site accident sample (73.8%)
[5] Overall percentage of property damage accidents in Phases II, III, IV, V in-depth accident sample (69.1%)

* $p \leq .05$
** $p \leq .01$
*** $p \leq .001$

6.0 Driver Conditions and States in Combination with Other Factors

Accidents can be described as a malfunction in the vehicle-driver-road system, and as such the search for an "accident cause" is a meaningful search into the component that failed and type of failure that occurred. However, as a system it is a very forgiving one in the sense that a driver can often operate outside of the system's design limits (e.g., speed) and still avoid an accident. Driver "errors" such as inattention, improper lookout, excessive speed, or inadequately-defensive driving technique do not necessarily end up in an accident because other parts of the system may compensate for them, such as fast reaction time on the part of the driver or skills in emergency braking and steering, a forgiving environment consisting of wide and hard shoulders, etc. Very often it is a combination of factors that cause the accident (see Section 3.3, Figure 3-11) in which case given all the other factors, the addition of, say, inattention at a critical moment causes an accident.

Of particular interest here is the causal factor category defined as human conditions or states, i.e., impairments in the driver's physical or mental conditions. These conditions may limit the driver—the decision making component in the system—to the extent that the flexibility to compensate for other error or problem sources is effectively lost.

The purpose of this section is to investigate the interactions of causally-implicated driver conditions and states with both human direct causes and environmental causal factors.[1]

6.1 Driver Conditions and States and Human Direct Causes

According to several theories of human factors in highway accidents (Perchonok, 1972; Fell, 1976), every direct human factor can be traced to a predisposing human state or condition. In this sense a human condition or state may be viewed as a human indirect cause. However, for 618 out of 720 drivers tested and interviewed in-depth, no indirect human causal factors could be detected; i.e., the driver was not—as far as the accident investigators could tell—significantly (causally) impaired, either physically or mentally. For the remaining 102 drivers, one or more human states or conditions were cited by the in-depth accident investigation team as an indirect cause of the accident. Since the assessment of direct and indirect human factors (states and conditions) is based on somewhat different sources of information, it is meaningful to look at the interaction of the two types of causal factors. Specifically, it is important to know what types of errors drivers are liable to make under specific mental or physical states. **The issue is, given the causal implication of a certain human state (e.g., intoxication) in an accident, what is the likelihood of also committing certain direct human errors (e.g., speeding).** An answer to this question could provide useful information to both drivers and highway officials concerning possible remedial techniques.

In order to answer this question, cross tabulations of frequency counts of direct vs. indirect causal factors were made. To maximize the sample size, all three levels of certainty were included in the tallying of indirect human causes. On the other hand, to reduce the probability of chance associations, only direct causes cited at the probable level were included.

[1] The arguments and conclusions below are based on the assumption that the procedures of attributing direct human causes and the procedures of attributing human conditions and states are independent of each other.

6.1.1 Analytical Approach

The general hypothesis investigated was: Does the causal involvement of a given Human State or Condition in an accident influence the probability that a particular human (Direct Cause) error was also implicated as a cause of the accident. Stated formally:

$$P(X_i|Y_j)/P(X_i)/1$$

where: $P(X_i|Y_j)$ is the conditional probability of Direct Cause X_i given Condition or State Y_j. $P(X_i)$ is the marginal probability of citing Direct Cause X_i.

The expression above will be referred to as the Relative Involvement Factor (RIF) of Direct Cause X_i due to the contribution of the Human State or Condition Y_j. The power of the RIF is that it allows the revision of estimates of causally-implicated driver behavior probabilities, given information about the causal implication of driver Conditions and States. The RIF of the various combinations of Direct and Indirect Causes can be written as:

$$\begin{aligned} RIF &= P(X_i|Y_j)/P(X_i) \\ &= P(X_i,Y_j)/P(X_i)P(Y_j) \\ &= \frac{n_{ij}N}{n_{i.}n_{.j}} \end{aligned}$$

where: $P(X_i,Y_j)$ is the joint probability of Direct Cause X_i and Condition or State Y_j; $P(X_i)$ is the marginal probability of Direct Cause X_i; $P(Y_j)$ is the marginal probability of Condition and State Y_j; N is the total number of drivers in the sample; $n_{i.}$ is the number of times Direct Cause X_i was cited at the probable or certain level; $n_{.j}$ is the number of times Condition or State Y_j was cited at the possible, probable, or certain level; and n_{ij} is the number of times Direct Cause X_i occurred in conjunction with Condition and State Y_j. Thus, for any given combination, a RIF >1.0 indicates that Condition Y_j increases the likelihood of human error X_i. Similarly, if RIF < 1.0, Condition Y_j decreases the probability of Direct Cause X_i.

While the RIF can be a very telling index, it is also desirable to estimate its statistical significance. This was done by assuming that the probability of accident-producing Direct Cause occurrences in the population of accident-involved drivers conforms to the assumptions of Bernoulli trials. The binomial distributions were then used to calculate the exact probability of observing n_{ij} or more occurrences of Direct Cause X_i, given $n_{.j}$ trials and a success probability of $P(X_i)$.

The RIF does have one limitation—arising from the fact that maximum RIF is not independent of $P(X_i)$. Maximum RIF decreases as $P(X_i)$ increases; from 10.0 at $P(X_i) = .10$, to 1.0 at $P(X_i) = 1.00$. As long as the marginal probabilities are both small and similar—as in the case for all the direct factors here ($.01 \leq P(X_i) \leq .14$)—then the comparisons of RIFs across various combinations of direct-indirect causes are valid and meaningful. However, when $P(X_i) = .4$, as it is for all the "other direct causes" combined, RIF max. = .25 and comparisons between the pooled "other direct causes" and the specific ones discussed below become difficult.[2]

The information provided by the RIF goes one major step beyond the typical non-explanatory findings in that condition X (e.g., alcohol) increases the likelihood of accident involvement. To the best of our knowledge this is the first time that the influence of driver conditions on direct human accident causes is determined from actual field data. Typically such relationships are speculated on the basis of controlled laboratory experiments in which the influence of a given condition (e.g., alcohol) on a driving related ability (e.g., tracking) is measured. The results obtained here are more direct and therefore more relevant to possible preventive and remediation programs.

6.1.2 Results and Discussion

To avoid tenuous speculations based on small samples, the discussion below is limited to those Conditions and States cited at least 10 times ($n_{\cdot j} \geq 10$). For this reason, the effects of physical handicap (one case), roadway overfamiliarity (two cases), and pressure from other drivers (six cases), will not be discussed. Similarly, since the number of times the Direct Causes: "failure to observe and stop at a stop sign," "external distraction," "misjudgment," "false assumption" and "improper manuevers" occurred jointly with any Condition and State was two or less ($n_{ij} \leq 2$), analyses of these factors were not attempted. For the remaining direct and indirect factors, the involvement factor, significance and number of cases on which it is based is presented in Table 6-1.

Before proceeding to individually discuss each of the indirect causes, two general observations can be made from Table 6-1:

1. The RIF for a given Direct Cause varies markedly as a function of the Condition or State.
2. Some Conditions and States may — while increasing the likelihood of some errors — also decrease the likelihood of other errors. Thus, they act as enhancing variables for some Direct Causes and as attenuating variables for others.

Alcohol Impairment: While the extent of the impact of alcohol on highway accidents is still

[2] An alternative approach is to develop a relative involvement index (RII) which will always vary from -1 to+ 1 and be independent of the **absolute** value of P(X). RII could then be defined as

$$RII = \frac{(X|Y) - P(X)}{1 - P(X)}$$

This concept may be more appealing especially when $P(X) > .5$.

Table 6-1

The Relative Involvement Factor (RIF) of Direct Human Errors as a Function of Causally-Implicated Human Conditions and States (numbers in parentheses represent N in each cell)

Direct Human Causes	Human Conditions and States									
	Alcohol Impairment	Other Drug Ipairment	Fatigue	Reduced Vision	Emotional Upset	In a Hurry	Driver Inexperience	Vehicle Unfamiliarity	Area Unfamiliarity	Total +
Critical Non Performance	5.52* (2)	0	22.22*** (5)	0	0	0	0	0	0	(9)
Inattention	0*	1.64 (3)	2.42* (4)	0	2.91** (4)	1.82 (3)	.64 (1)	0	.78 (1)	(66)
Internal Distraction	2.61* (4)	1.89 (2)	1.05 (1)	0	0	0	2.22 (2)	0	1.35 (1)	(38)
Improper Lookout	0**	.35 (1)	.78 (2)	2.54* (4)	0*	1.55 (4)	.41 (1)	.70 (1)	.50 (1)	(103)
Improper Driving Technique	1.91 (3)	.92 (1)	0	1.68 (1)	2.46 (2)	3.08* (3)	1.09 (1)	0	0	(39)
Excessive Speed	3.01*** (8)	1.64 (3)	1.21 (2)	0	1.45 (2)	3.03** (5)	1.28 (2)	3.27* (3)	6.23*** (8)	(70)
Improper Evasive Action	.89 (2)	1.93 (3)	.71 (1)	1.17 (1)	0	.71 (1)	2.27 (3)	2.57 (2)	0	(59)
Over-Compensation	2.98* (3)	1.44 (1)	0	0	0	0	1.69 (1)	2.88 (1)	0	(25)
Inadequate Directional Control	2.61 (2)	1.89 (1)	0	0	0	0	6.69*** (3)	11.37*** (3)	0	(19)
Other Direct Causes	.42*** (5)	.60 (5)	.40** (3)	1.09 (5)	1.12 (7)	.27* (2)	.42** (3)	0***	.52 (3)	(299)
Total (N)	(29)	(20)	(18)	(11)	(15)	(18)	(17)	(10)	(14)	(720)

+Cell frequencies in each row do not add up to row totals since for most Direct Causes no Condition or State was identified.

* Significant at $p < .10$
** Significant at $p < .05$
*** Significant at $p < .01$

being disputed (Zylman, 1975), its detrimental effects on driving-related skills are well-documented (c.f. Perrine, 1973). The data here suggests that its most common immediate effect is to increase dramatically — by a factor greater than 5 — the likelihood of a critical non-performance being implicated as a Direct Cause (critical non-performance is typically characterized by dozing or falling asleep at the wheel). It is implied that the depressant effect of alcohol is sufficiently large to result in total (critical) non-performance rather than, for example, just a reduction in the attention level (i.e., inattention).

To a lesser extent, but still by a significant factor of two to three, alcohol increases the likelihood of the causal involvement of speeding, overcompensation, and being internally distracted. If we view the accident as the end event along a temporal sequence of events, then except for overcompensation all the Direct Causes mentioned above reflect errors prior to entering the imminent accident situation. Once the accident is imminent, the effects of alcohol are on response execution (overcompensation — RIF = 3.0) rather than response **selection** (improper evasive action — RIF = .9).

It is interesting to note that alcohol suppresses improper lookout. This may be due to the fact that in a situation requiring lookout to the sides (e.g., intersections), the driver, aware of his state, tries to be extra careful. Differences in the times, places, and circumstances under which the impaired driver drives may also be responsible.

Other Drug Impairment: This category is a catchall for a variety of drugs that have a wide range of physiological effects (e.g., it includes both stimulants and depressants other than alcohol), and as a result the interpretation of the RIF values is more difficult here. It is possible that the differences between the drugs cause all the RIFs to be close to 1.0, and statistically insignificant.

Fatigue: The most common effect of fatigue is obvious here — critical non-performance, i.e., dozing or falling asleep (RIF = 22.2). Another effect of fatigue is one of overall reduction of alertness, i.e., inattention (RIF = 2.4).

Reduced Vision: Visual impairment appears to interfere with the driver's visual search behavior (RIF = 2.5). Here the driver's main problem is that he is not aware of what he doesn't see or sometimes even of the fact that he is suffering from reduced vision. For example, a driver with a narrow field of view (< 100°) is often unaware of his relatively limited field. It is possible that increased awareness of the problem coupled with training in effective visual search behavior might reduce the RIF for improper lookout.

Emotional Upset: The emotionally upset driver is typically preoccupied with thoughts about the source of his emotions; these in turn may reduce his attention to driving task requirements (e.g., inattention RIF = 2.9). This immediate relationship exemplifies the driver's limited attention capacity and the dangers involved in overloading this capacity.

In a Hurry: Being in a hurry not only causes drivers to speed (RIF = 3.0) but also to abandon proper driving techniques (RIF= 3.1). Speeding and improper driving techniques are both employed by the driver as time-saving strategies that significantly increase the likelihood of being involved in an accident. However, an increase in speed requires an increase in the rate of information processing, and when this rate is greater than the driver's channel capacity (e.g., in the case of a low probability accident-causing event), an accident is likely to occur.

Vehicle Unfamiliarity: As might have been expected, lack of vehicle familiarity becomes critical in those situations where the ability to maintain adequate directional control (RIF = 11.4) can prevent an accident. Interesting, but more difficult to explain, is the high RIF for excessive speed (3.3). This might reflect an attitude of "testing" the limit of the new vehicle, or misperception of true speed. Driver age variables might also be responsible.

Area Unfamiliarity: Area unfamiliarity has a singular effect of increasing the relative involvement of excessive speed as a causal factor by a factor of six! It should be noted that in the causal assessment process, excessive speed is assessed relative to the design speed for the road segment, which is most often a curve. Wherever the driver encounters an unfamiliar area, he is likely to speed excessively if the design speed does not conform to his expectations based on his perception, immediate past experience with the previous road segment, and the signing information available.

Driver Inexperience: Driver inexperience is associated with inadequate directional control (RIF = 6.7), indicating the lack of knowledge or appropriate execution of proper steering inputs on the part of drivers whose inexperience was judged to cause an accident. Driver inexperience is shown to be unrelated to excessive speed and improper driving techniques.

6.1.3 Conclusions and Recommendations

The Relative Involvement Factor (RIF) was shown to be a useful statistic in describing the interactions between human Direct Causes of accidents and human Conditions and States. Depending on what Conditions and States are judged to be causally involved, the likelihood of a particular human Direct Cause being implicated varies considerably. The actual cell frequencies on which the RIF is based are typically small and the relationships described above would definitely have to be substantiated in a different sample before they can be regarded as stable. Considering that the purpose of this initial study was to demonstrate the utility of this approach to accident analysis, the results, especially with the small sample size, are sufficiently reliable to yield statistically significant relationships.

While it is tempting to assume that the implicated Conditions and States lead to and explain the associated Direct Causes which tend to occur with them (and while this is undoubtedly part of the explanation), no such clear-cut explanation is warranted. This is because the RIF is based here on observational "field" data rather than on experimental cause-and-effect manipulation of the conditions and states. The validity of the RIF as a measure of **causal** relationship depends on the underlying theory one has concerning human factors in highway collisions. To illustrate, while fatigue may indeed lead to falling asleep, it is questionable that alcohol impairment improves the visual search behavior as suggested by a suppression of improper lookout errors. This is because direct measures of roadway scanning as reflected by eye movements show that alcohol in fact **decreases** the normal eye movement activities (Kaluger and Smith, 1970). It is more likely that the drivers in the present sample —

being aware of their state of intoxication — "looked" more carefully, thus not committing any immediately observable improper lookout behaviors though their lookout ability was in fact impaired. Secondly, association between direct and indirect causes may be an artifact of other confounding variables. For example, improper lookout occurs mostly at intersections when traffic density is high. In contrast most intoxicated driving involves more rural travel under low density (late) conditions. Finally, it is also possible that there are biases in the way causes are assessed. For example, given the same information regarding a driver's level of rest or fatigue, there may be a greater tendency to cite fatigue as a causative Condition or State when the Direct Cause is falling asleep rather than excessive speed. Conceptually and in application, the judgments (as to Direct and Indirect Causes) are intended to be independent, but the degree of this independence has yet to be established. Nonetheless, the fact that the RIF reveals some unexpected associations, suggests that the judgments are relatively independent.

Still, these results are interesting when viewed from the perspective of indicating what kinds of Direct Causes are most likely to occur in combination with a particular Condition or State. Results obtained with this technique, based on real-life data, have immediate implications for accident-reducing countermeasures. To illustrate, if future studies yield the same pattern of relationships observed here, then immediate applications to driver education or improvement and public information programs might be to:

1. Stress that if driving while under the influence of alcohol, key concerns are to avoid falling asleep and speeding. Note that while the point on speeding may be well-known, recognition of falling asleep as a problem — like the increased risk of internal distraction — may be much less prevalent.
2. Stress that when emotionally upset, drivers should make special efforts to keep their minds on their driving and to remain attentive.
3. Place added emphasis on informing new (inexperienced) drivers of the need to avoid being internally distracted (e.g., by passengers or adjustment of tape players). An emphasis on proper evasive action and retaining control may also be indicated.
4. Stress to drivers operating unfamilar vehicles the increased risk of control loss.
5. Stress the importance when driving on unfamiliar roads of consciously reducing speed to account for unexpected, deceivingly tight or unusually slippery curves.

6.2 Driver Conditions and States and Environmental Causal Factors

In our very forgiving transportation system the driver—as the most flexible component—often finds it necessary to modify his behavior in order to correct for various degradations in the environment. These may be due to either weather, topography or design. The key issue addressed here is to what extent do human indirect causes (i.e., conditions and states) reduce the driver's ability to overcome the environmental hazards posed by the environmental factors studied below.

The analytical approach here is identical to the one in section 6.1. The Relative Involvement Factor (RIF) was calculated for every combination of human state and environmental condition, based on the cell and marginal frequencies of the two causal factor categories. In this case RIF indicates the extent by which a given causally implicated human state increases the likelihood that a given environmental degradation will cause an accident.

Before proceeding to the results themselves, one important methodological comment is in order. For the tabulation of human direct-indirect causes, an homomorphic relationship existed between the direct and indirect casues, i.e., every indirect cause was mapped into one or more direct causes. This is not the case here since in 56% of the cases where an indirect cause was cited, no environmental cause was cited. As a result, the cell frequencies are typically smaller; and as a consequence, both the results and the discussion below should be considered tentative pending a larger data base.

6.2.1 Results and Discussion

The RIFs for all the human condition and state factors cited seven times or more, or with a specific cell frequency (n_{ij}) > 2, are presented in Table 6-2. The remaining discussion will be based on this table.

Alcohol and other drugs

The data do not seem to indicate any differential effects of alcohol (or any of the other drugs encountered) in conjunction with environmental causes. Alcohol, if relevant at all, appears to be a suppressing variable for view obstructions, suggesting that intoxicated drivers may be attempting to be overtly more careful. Differences in exposure could also be responsible.

Reduced vision

Reduced vision as a driver variable interacts only with view obstruction (RIF = 2.6), which constitutes an additional reduction in visibility.

Emotional upset

This factor is apparently independent in its effects of any specific environmental factor.

Pressure from other drivers and being in a hurry

Despite some large RIFs none of the interactions of these states with environmental causes was significant.

Driver inexperience

When inexperience was assessed as being causally-related, drivers were four times as likely to have an accident in which bad highway design was cited as a cause, as when it was not (RIF = 4.1). Perhaps the more experienced the driver the more familiar he is with bad highway

Table 6-2

The Relative Involvement Factor (RIF) of Environmental Causal Factors as a Function of Human Conditions and States (numbers in parentheses represent N in each cell†)

Environmental Causal Factor	Human Conditions and States									
	Alcohol Impairment	Other Drug Impairment	Reduced Vision	Emotional Upset	Pressure from Other Drivers	In a Hurry	Driver Inexperience	Vehicle Unfamiliarity	Area Unfamiliarity	Total
Slick Roads	1.15 (2)	1.80 (2)	0	2.40 (2)	0	2.54 (3)	1.44 (1)	3.92** (3)	2.05 (3)	(50)
Control Hindrance	0	0	0	0	0	0	0	3.64 (1)	5.71*** (3)	(18)
Inadequate Sign or Signal	1.11 (1)	0	0	0	3.46 (1)	0	0	2.52 (1)	5.27*** (4)	(26)
View Obstruction	.28 (1)	0*	2.62* (3)	0	1.75 (2)	1.64 (4)	.69 (1)	0	.33 (1)	(103)
Design Problems	.82 (1)	0	0	0	2.57 (1)	1.21 (1)	4.11* (2)	5.61** (3)	4.90*** (5)	(35)
Other Environmental Factors	.91 (2)	.71 (1)	0	1.90 (2)	1.42 (1)	.67 (1)	0	0	1.09 (2)	(63)
No Environmental Factors	1.07 (18)	1.20 (13)	0.93 (5)	0.99 (8)	.55 (3)	.70 (8)	.89 (6)	.40 (3)	.21** (3)	(486)
Total	(25)	(16)	(8)	(12)	(8)	(17)	(10)	(11)	(21)	(720)

† Whenever RIF = 0, N = 0
* Significant at $p < .10$
** Significant at $p < .05$
*** Significant at $p < .01$

designs, and the more able he is to respond to them. It may therefore be worthwhile to familiarize beginning drivers with some "bad" (though common) design situations.

Vehicle and area unfamiliarity

Vehicle and area unfamiliarity amplify the effects of environmental problems more than any other human indirect causes. Vehicle unfamiliarity (if cited as a cause) increases the likelihood of an accident due to design problems by a factor of 5.6 and quadruples the danger of slick roads. Both factors require quick action from the driver in order to avoid an accident. Vehicle unfamiliarity makes **quick appropriate** action very difficult, as was shown in the previous section where vehicle unfamiliarity yielded a RIF of 11.37 for inadequate directional control.

The effects of causally-implicated area unfamiliarity are similar but more pronounced. The driver who is unfamiliar with the road is five times as likely to have an accident due to control hindrances (RIF = 5.71), and five times as likely to be affected by inadequate signs or signals (RIF = 5.27). The direct error most commonly associated with causally-implicated area unfamiliarity was excessive speed. Thus, although the environmental factors are similar for vehicle and area unfamiliarity, the direct errors involved are not. In any case, countermeasures that would reduce or eliminate control hindrances, inadequate signs, and design problems would be highly beneficial on roads used by drivers unfamiliar with the area and/or their cars.

6.2.2 Conclusions and Recommendations

The results of the analysis above suggest that environmental factors are most likely to increase the accident involvement of visually-impaired drivers or "inexperienced" drivers (unfamiliar with either the vehicle, the area, or the driving task). In the first case, that of reduced vision, the danger of view obstruction is increased. As noted above, restricted vision (typically field) makes overcoming new obstructions more difficult in general, and increases the probability of view obstructions being implicated as accident cases, in particular. The second influence of environmental factors — on inexperienced drivers, and drivers unfamiliar with the vehicle or area — could be due to the effects of violating driver expectancies. The three significant environmental factors — control hindrances, inadequate signs or signals, and design problems — have one attribute in common: they all violate the norms of clearances, signing and roadway design and thus present the driver with an unexpected situation. Since expectancy is known to be a critical variable in driver information processing (typically by delaying the appropriate response) it is not surprising that the less experienced drivers are the ones that are most likely to be affected when common expectancies are violated.

Although the conclusions drawn here are based on an even smaller sample than those that relate human conditions and states to direct human errors, they do point the way toward possible remedial actions, such as:

1. Emphasis on removal of view obstructions in environments where there is a greater

frequency of elderly or visually-impaired drivers (near nursing homes, eye clinics, etc.).

2. **In areas overrepresented by inexperienced drivers (e.g., license bureaus), drivers** unfamiliar with their car (e.g., car dealerships), or drivers unfamiliar with the area (e.g., popular tourist spots or detours), special effort could be made to remove control hindrances and compensate for bad signing and design by early warning or information displays.

7.0 Analysis of Assessment Practices

7.1 Introduction

The heart of the causal assessment process is the conclusion and analysis (C & A) session in which representatives of the three disciplines involved in investigating the accident—an automotive engineer, an environmental specialist, and a psychologist—meet together with a technical writer and attribute causal factors to the accident. Since this critical stage in the accident investigation process is based on **subjective judgments of experts,** it was deemed important to be able to evaluate it quantitatively. The purpose of the analysis below is **to examine selected aspects of the reliability and validity** of the C & A procedure in light of amendments made to the existing structure. The procedure was augmented by collecting additional numerical subjective probabilities and then performing several statistical analyses aimed at providing some additional measures of validity and reliability of both the C & A process and the C & A outcome in terms of the assignments of causal factors.

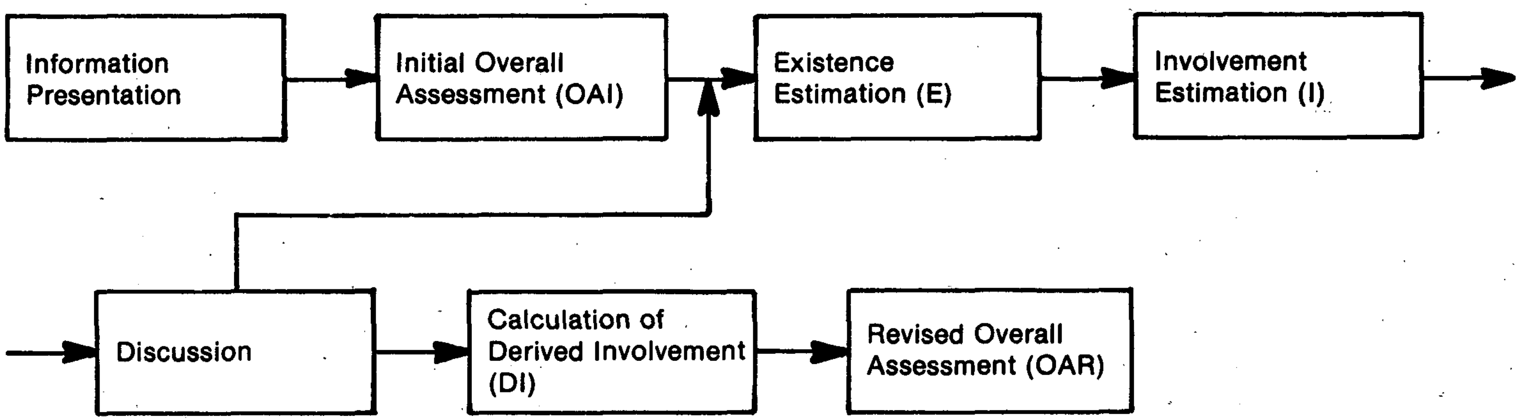
It should be stressed that the two ultimate criteria for reliability and validity of the C & A procedure described below were not tested, and in fact may be impossible to test. With respect to reliability, the standard method of test-retest reliability was not practical since the level of familiarity achieved with the case in the process of analyzing it is so high that it is not possible to assume that two analyses of the same case by the same people are independent. With respect to validity, the problem here is the absence of any independent and — more important — valid accident cause criterion. In fact, the MDAI in-depth analysis may be at present the most definitive method of clinical accident cause analysis. Nonetheless, the validity of certain aspects of the procedure can be tested, as will be described below.

To facilitate the discussion below, Figure 7-1 depicts, in a flow chart form, the C & A process. The major stages in that process involve:

1. Presentation of all relevant information—human, vehicular and environmental.
2. Identification of causal factors.
3. Probability assessments of the significance of the causal factor.
   - **a** Initial overall assessment (OAI) in terms of "certain," "probable," and "possible."
   - **b** Probability estimation of the existence (E) of the factor in the accident situation, where $0.00 \leq E \leq 1.00$.
   - **c** Probability estimation of the involvement of the factor (I). Involvement is defined as the probability that the accident would have been prevented had the factor not existed. $0.00 \leq I \leq 1.00$.
4. A discussion is held whenever there is a large discrepancy in the members' estimates. Following such a discussion members are given the opportunity to revise their E and I estimates.

Figure 7-1

The Primary Stages in the C & A Procedure



5. The derived involvement, which is the product of the mean E and I is calculated.
6. With the benefit of all the previous discussions, members reassess the overall involvement of the factor in terms of "certain," "probable," or "possible."

The issues tested within the general objective can best be stated in terms of research questions (hypotheses) towards which statistical analysis and tests were applied:

1. What is the correspondence between the numerical confidence ratings (on the 0-1.0 scales) of derived involvement (DI) and the categorical ratings (certain, probable, possible) of revised overall assessment (OAR)? As originally conceptualized, the categorical ratings were assigned confidence ranges in which $.95 \leq$ certain ≤ 1.0, $.80 \leq$ probable $< .95$, and $.20 \leq$ possible $< .80$. Although these values were implicit in the judges' minds during the C & A session, the use of numerical assessments permits an actual test of this correspondence.

2. Assuming that the categorical rating of causality is valid, would the revised process of numerical ratings of existence (E) and involvement (I) of a causal factor, and the mathematical derivation of overall assessment (DI) also be valid? The issue is one of concurrent validity, which involves correlating the two (for a discussion of different validity concepts see Cronbach, 1960).

3. Are the judges' ratings on existence and involvement of causal factors **independent** of each other? The analytical procedure for the derived overall assessment **assumes** that the values of existence and involvement are independently assessed. This functional independence should also show up as statistical independence.

4. Does the discussion, following the presentation of information and initial listing of factors, affect any of the members' assessment? Assuming that a change in the vote is always for the better (since it involves greater awareness of additional data), the correlation between the initial and revised overall assessment should be high but not 1.00.

5. Are the ratings criteria used by the judges the same in judging human, vehicular and environmental involvement? If the judges are consistent in their use of numerical and categorical confidence ratings, then the range of values for each of the three levels of confidence should be the same across all areas of causal factors (human, vehicle, environment).

6. Are the confidence ratings criteria similar for all judges or are there consistent differences among judges? If the numerical rating methodology is valid and relatively stable across judges, then differences among judges should be random (across cases) rather than consistent, reflecting a bias towards either conservatism or extravagance.

7. Are judges, expert in the different areas, able to maintain the same criteria for factors in their area of expertise as for factors in other areas. In other words does the engineer give more weight to vehicular factors, the psychologist to human factors, etc? It can be agreed that an objective and sufficiently detailed accident analysis and information presentation should both reduce the variance among judges, and lessen such biases.

7.2 Methodology

The numerical ratings procedure was developed rather late in the project, and it was felt that a fair test of its value should not include the first several accidents subjected to it. For this reason the sample of cases used for the methodology evaluation was limited to accidents analyzed between January 1 and May 1, 1975.

The sample on which the following statistics are based consists of 36 accidents, or 54 traffic units. Across all the cases a total of 136 factors were listed, and since a judgment for each factor was obtained from each of the three judges (experts in the human, vehicular and environmental areas), the analyses below are based on a sample of 408 judgments.

There were seven team members and two technical writers involved in the sampled cases. Since the writer's involvement is mostly limited to conducting the C & A session, and his participation in the actual voting procedure is limited to special situations (see Section 2.0), the evaluation of the C & A procedure was based on the ratings obtained from the seven speciality-area experts. In any one C & A session only one expert from each area participated, and the assignment of judges to cases was counterbalanced in order to prevent biases due to a particular "team" combination.

7.3 Results and Discussion

The discussion below is organized in terms of the issues raised in the introduction.

1. A test of the correspondence between the numerical and categorical ratings was conducted by plotting density and cumulative probability functions of the numerical ratings separately for each of the categories of the revised overall assessment (OAR): certain, probable, and possible. These plots are presented in Figure 7-2. From these plots it can be observed that the median confidence level of a "certain" rating is .90, the median for "probable" is .73, and for possible it is .42. These values indicate that when using the "numbers system" (i.e., providing quantitative estimates of probability) the judges are more conservative in their estimates than they are with verbal categories. Using the interquartile ranges for bracketing purposes, the emerging derived probability estimates for the three categories are:

Certain $.88 \leq p \leq 1.00$
Probable $.62 \leq p \leq .79$
Possible $.32 \leq p \leq .50$

These values are useful as indicators of the qualitative relationship between the two approaches. They are deficient however since they are not exhaustive in that they do not cover the whole range of possible derived values (e.g., .80 - .87). Thus while they are fairly accurate representations of what each of the labels correspond to, they cannot serve to define the range of probability values applicable to that category. A logically better approach would be to determine the cutoff values between adjacent categories from the probability density distributions in Figure 7-3. Although the three categories were originally designed to be

Figure 7-2

Cumulative Frequency Distributions of Derived Involvement (DI) as a Function of "Certain" (a), "Probable" (b), and "Possible" (c) Revised Overall Assessments (OAR).

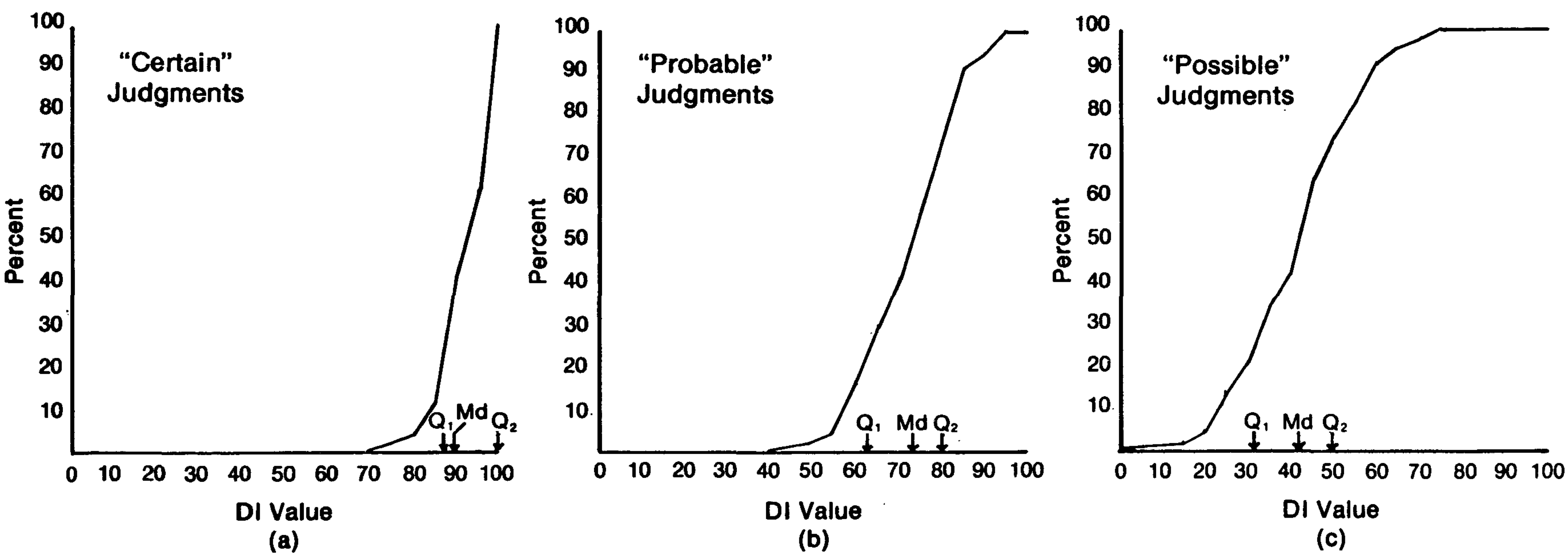
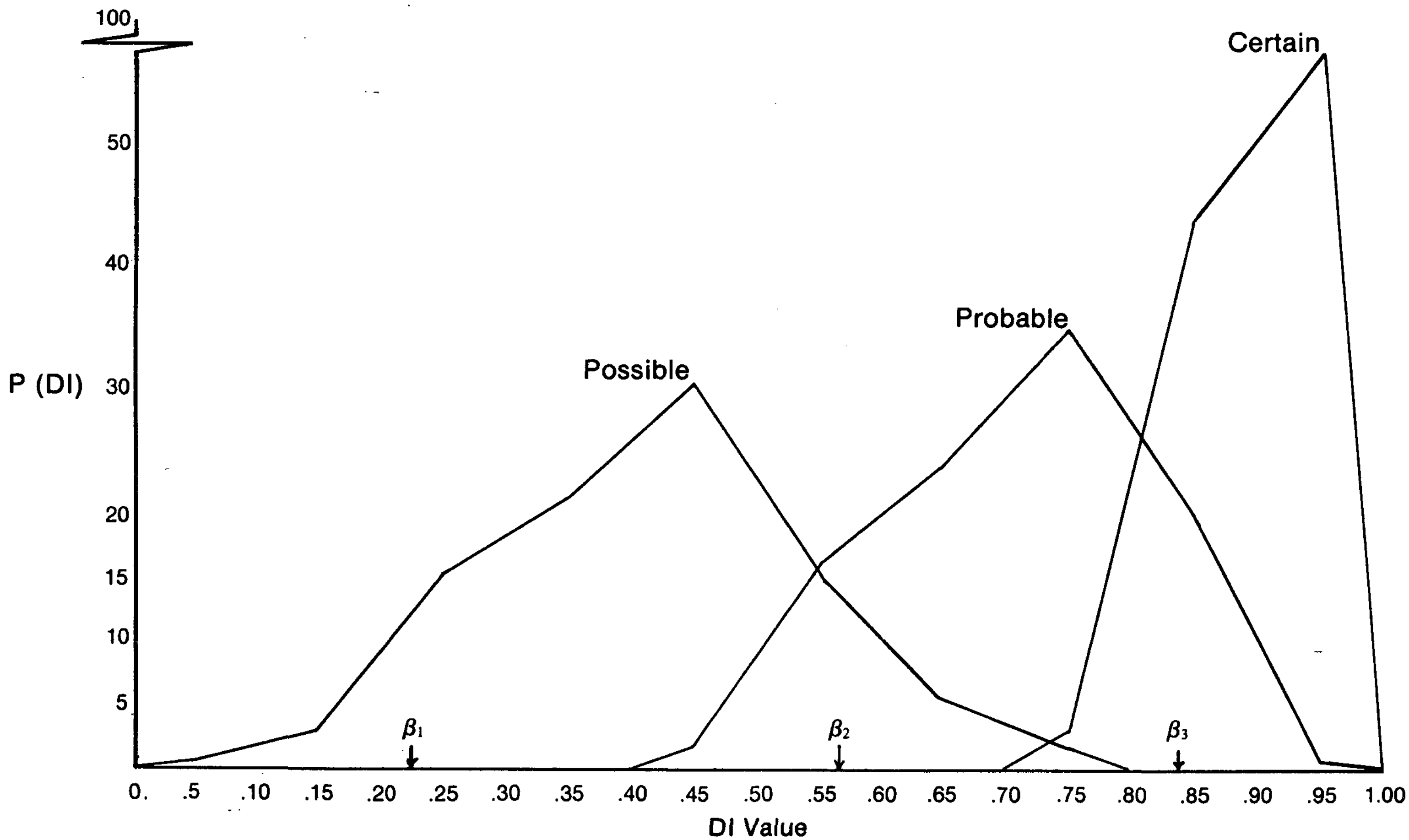


Figure 7-3

Probability Density Functions of "Possible," "Probable," and "Certain" Judgments (β_1, β_2, β_3, Represent the 10% Error Cutoff Levels)



exhaustive and mutually exclusive, it is apparent that there is a significant overlap in the distributions. This overlap is an expected outcome for human judgments in which "noise" or error is always involved. From these distributions "optimal" cutoff points can be obtained by assigning values to over-estimation and under-estimation errors. For simplicity sake we assume that (1) both errors are of equal cost (negative value) and (2) the density distributions are symmetrical around the mean (justified on the basis of the Q_1 and Q_2 distance from the Md in Figure 7-2 for the probable and possible categories). The optimal cutoff points are designated as β in Figure 7-3 and indicate equal error levels in each category. According to this approach the correspondence between the derived numerical categories (DI) and the direct verbal categories (OAR) is:

Certain $.84 \leq p \leq 1.00$ (10% overlap with probable)
Probable $.56 \leq p \leq .84$ (10% overlap with certain and possible)
Possible $.23 \leq p \leq .56$ (10% overlap with probable and out[1])

The general conclusion emerging from these analyses is that judges are either conservative in their use of the numerical ratings or extravagant in their assignment of the verbal labels of certain and probable causes. It is likely that both effects are operating here, and in any case the magnitude of the deviation of the derived causality from the previously defined values for certain, probable and possible is not large. Since the derived probability is a product of two values both not greater than 1.00, it is possible that the direct overall assessment fails at the multiplication process rather than the assessment of either existence or involvement. Whatever the source of error, it may be beneficial for future data gathering purposes to determine the qualitative label (i.e., certain, probable, and possible) on the basis of the DI value only after the C & A has been completed. This approach would then make the three levels of confidence mutually exclusive and more rigorously defined.

2. To validate the revised C & A procedure and the DI statistic we assume that the revised categorical assessments (OAR) are valid, and check for the concurrent validity of DI by correlating it with them. Tests were run on each in-depth team member involved in the assessment procedure. The results of this analysis are provided in Table 7-1, Column 1. All the correlations are significant and exceed .73. The degree to which the correlations are less than 1.00 is also evident in the overlap between the three distributions in Figure 7.3 Thus DI may be assumed to be a valid — and perhaps better — indicator of causality.

The argument that DI is a better statistic of accident causality is based on the fact that it is more likely that the experts can assess the marginal probability of a factor's existence (E) and the conditional probability of its involvement (I), than directly assess the complex product of the two.

3. The test for independence of existence and involvement was performed by correlating the

[1] 'Out' designates a factor whose possible contribution is believed to be too low for inclusion in the list of causal factors.

Table 7-1

Correlations Between Initial Overall Assessment (OAI), Revised Overall Assessment (OAR), and the Numerically Derived Involvement (DI), and between Existence (E) and Involvement (I).

Participants	OAR[1] / DI	E[2] / I	OAI[1] / OAR
D.S.	.83	.46	.88
D.Z.	.73	.45	.69
R.H.	.87	.56	1.00
R.R.	.80	.45	.82
R.S.	.81	.23	.63
P.C.	.81	.21	.92
N.T.	.78	.86	.89

[1] Kendall's Tau correlations
[2] Pearson's Product Moment correlations
All correlations greater than .23 are significant at $p \leq .05$

two judgments and the results are presented in Table 7-1, Column 2. While the correlations in column 2 are lower than in the other two columns, they are, nonetheless, statistically significant (except for R.S. and P.C.). The effect of the first judgment (E) on the second is however small ($r^2 < .32$) except for N.T. who was least familiar with the revised methodology (made only 16 judgments). Correspondingly, the correlation was lowest for P.C. who was the most familiar with the methodology (120 judgments). Thus, it is possible that increased familiarity with the methodology improves the judgmental skills required. It is further likely that the selection of factors to be considered in the C & A was a priori biased in the direction of selecting factors that would be relatively high on both E and I, thus eliminating those factors that would be low on either E or I, and as a consequence artificially raising the apparent correlation between the two measures.

4. While the time needed to present the information prior to the beginning of the rating process is typically less than one hour, additional clarifications and discussion after this phase often occur and inevitably consume more time. The value of these discussions was assessed by comparing the initial overall assessment (OAI) with the revised one (OAR) made at the end of the C & A session. The correlations for each of the judges are presented in Table 1, Column 3. Except for one judge, it appears that the additional discussion is useful, and does lead to changes in overall assessment. The lower correlations (D.Z. and R.S.) may also reflect

susceptibility to conformity, an unavoidable artifact of group decision making.

5. To test for the stability of the ratings across the different areas of causal factors, the mean DI and its standard deviation were calculated at each level of OAR for each of the four areas: human direct causes, human conditions and states, environment, and vehicle. The results along with the tests of significance are presented in Table 7-2. Only for the "possible"

Table 7-2

Mean DI Value (and Standard Deviation) for Each of the Three Confidence Categories as a Function of the Causal Factors.

	Confidence Category		
Causal Factor	Possible	Probable	Certain
Human Direct	.41 (.13)	.74 (.10)	.92 (.06)
Human Conditions	.43 (.11)	.61 (.14)	1.00 (.00)
Environment	.45 (.14)	.69 (.11)	.94 (.09)
Vehicle	.36 (.15)	.72 (.07)	.97 (.05)
F-Ratio P	1.74 .16	3.12 .03	5.68 .00

judgments is the null hypothesis not rejected. In the "probable" case, judges are more conservative in assigning a numerical confidence rating to the existence and involvement of a human condition which may have played a causal role in an accident. In fact a certain rating for a human condition was given only in two cases in which the causality was unquestionable (driver fell asleep at the wheel). To summarize, it appears that the rating criteria used by the judges are fairly stable across the human, environment and vehicle areas. This is manifested also in the similarity of the standard deviations between areas within each OAR level. The only exception is in the area of human conditions where—unless absolutely certain—the numerical judgments are conservative.

6. The variability between judges, or the effects of individual differences, is critical for the C & A process because its outcome is based on subjective judgments. It is therefore important to note that the more objective and rigorous the methodology, the smaller would be the bias

arising from individual differences. To some extent the non-random error or bias was neutralized through counter-balancing of judges' participation in C & A sessions. It remained, however, to verify that no differences existed. The results of an analysis of variance are presented in Table 7-3 where mean DI is given for each judge and causal factor category combination. In the last column the mean DI for each judge across all factors are given. The differences among the judges are not significant both within factors and across all factors. The only difference approaching significance is in the vehicle area due to R.H., but this low value may be an artifact of the fact that only 3 vehicle factors were listed in the cases in which R.H. participated.

7. There remains the possibility that biases are not constant across all factors but are a function of the interaction between causal factor category and the area of expertise. Thus, the psychologist may be prone to overestimate the contribution of human factors relative to environmental or vehicular factors. The results in Table 7-3 do not support this type of bias either. In fact, when pooled across judges in each area of expertise, the similarity among experts is striking. When the mean DI is calculated for each area of expertise, the comparisons among areas of expertise is based on exactly the same cases (whereas comparisons between individual judges are not). Only in the case of vehicular factors is there a slight (but non-significant) tendency by engineers to assign greater weight to vehicular factors.

The results obtained above indicate: (1) a strong correspondence between the previously used overall assessment (OAR) and the assessment derived from the subjective estimates of the marginal probabilities of existence and involvement; (2) when the process is sufficiently defined, there are no strong biases due to judges tendencies to be either conservative or extravagant, as a function of their expertise in a specific area.

Aside from providing partial validation for the C & A process as it has been previously conducted, the use of numerical ratings offers some additional advantages by: (1) giving judges greater freedom by not restricting them to the three verbal categories only; (2) having judges apply their expertise to judging the simpler E and I probabilities rather than the more complex product of the two; (3) giving the reader a better grasp of the level of confidence involved in "certain," "probable," or "possible" categories once these are derived *post hoc* from DI; (4) making the results much more amenable to quantitative analysis once causality is defined on ratio or interval scales; (5) facilitating the group decision process since it is much simpler to average three numerical confidence ratings than, say two votes of "probable" and one of "possible." Two possible disadvantages of the numerical rating method of DI are that: (1) it requires some level of practice with the number system and (2) the ability to assess E and I independently is a skill that can only be acquired over time. These criticisms, however, can be applied to almost any group decision process, but in the present methodology the second shortcoming can be actually tested. In fact achievement of statistical independence (or some cutoff level) can be used as a criterion for evaluating a judge's ability to use the method adequately.

Table 7-3

Mean DI for Each of the Participants in the Causal Analysis Sessions as a Function of the Causal Factors.

Area of Expertise	Participants	Causal Factor: Human Direct		Human Conditions		Environmental		Vehicle		All Factors	
Human Factors	D.S.		.59		.46		.59		.48		.56
	D.Z.	(.66)	.73	(.48)	.49	(.61)	.63	(.50)	.53	(.58)	.68
Vehicular Factors	R.H.		.60		.52		.73		.20		.63
	R.R.	(.66)	.67	(.48)	.43	(.63)	.53	(.63)	.86	(.62)	.58
	R.S.		.69		.46		.70		.65		.66
Environmental Factors	P.C.		.64		.41		.61		.52		.66
	N.T.	(.65)	.71	(.45)	.60	(.60)	.56	(.52)	—	(.64)	.60
F. Ratio			1.31		.30		1.22		1.72		1.44
Significance Level	(p)		.25		.93		.30		.16		.20

The Entries in Parenthesis represent the Weighted (by the actual number of cases) Mean Factor Rating for the Participants from each of the Three Areas of Expertise.

8.0 Level B vs. Level C Comparisons

In the absence of an exhaustive and mutually exclusive set of possible accident situations, the probability of conflicting clinical assessments must be considered. The present causal assessment methodology is susceptible to judgment errors on the part of both the on-site and the in-depth accident investigators. Since there is no outside criterion against which the investigators' diagnosis may be compared, it is impossible to test the criterion validity of the on-site and in-depth assessment procedures simultaneously.

Two general approaches to data analysis—each yielding answers to different questions—are taken here. A conservative approach is to view both Level B and Level C assessments as approximations to the true cause, and study the relationship between the two in terms of **reliability** of the causal hierarchy, i.e., how well defined are the decision rules and definitions that guide the causal assessment. Analyses performed to this end are useful for the improvement of the accident cause hierarchy.

A second approach is to view the causal assessment made by the in-depth team (Level C) as valid (i.e., true cause) and then determine the **concurrent validity** of the on-site (Level B) assessment relative to the in-depth assessment. Analyses geared to evaluating Level B performance relative to Level C are useful since they provide the data needed for cost/effectiveness evaluations of Level C.

In a previous analysis [reference 1 pp. 91-116], a disagreement index was developed. This measure reflected the ratio of agreements/disagreements for each causal factor on the basis of a case by case analysis. The analysis indicated that for the most often cited factors the agreement ratios varied from 3.7 (high agreement) to .73 (poor agreement). As a statistic the disagreement ratio is useful in pointing out the factors that are either difficult to assess (at either the on-site or in-depth level) or are not sufficiently well defined. However, this ratio falls short of specifying **the source of the disagreement,** i.e., whenever disagreement exists, which causal factors are confused with each other?

The objectives of this analysis can be stated as questions at two levels:

- **a** Across all accident causes (1) what is the extent and nature of disagreements **between the in-depth and on-site teams and (2) what are the strengths and weaknesses of the hierarchy?**
- **b** Assuming that the in-depth team's causal assessment is the closest approximation to the truth, how good is the on-site assessment for each of the causal factors?

Since the answers to these questions involve different methodological approaches, they will be dealt with separately below.

8.1 Agreements/Disagreements Across Causal Factors

In order to examine the nature of disagreements, a B vs. C confusion matrix was generated for a random sample of 219 cases drawn from the total population of 420 in-depth cases.[1] To conduct the agreement/disagreement analysis, all the sampled cases were reread and the following three types of disagreements were identified: commissions/omissions, misidentifications, and coding errors. Since there is no external criterion against which the judgments can be evaluated, the citing of an accident cause by one team only (e.g., in-depth) can be labeled as either a commission error by that team (in-depth commission) or as an omission error by the other team (on-site omission). However, since in the course of causal assessment the in-depth team has access to the on-site team's report, it is more likely that in fact the omission/commission disagreements are on-site omissions and on-site commissions rather than in-depth commissions and omissions, respectively.

For purposes of the present analysis, an on-site **omission** error occurred when the in-depth team identified a certain, probable, or possible causal or severity-increasing factor, while in the same accident, the on-site team failed to identify the same factor. The reverse situation denoted an on-site **commission** error. Thus, if one team indicated a factor as only a possible cause, while the other team did not cite it at any level, an error was tabulated of one type or the other. This leads to a considerably harsher definition of "disagreement" than was applied in the previous report. At that time, an "error" (or "disagreement") would not have been tabulated in the above example; if one team had not cited a particular factor, no disagreement was cited unless the other team had cited it at the "probable cause" level or above. This difference in turn leads to the "agreement/disagreement" results in the present report appearing somewhat poorer than before. These definitions are probably of about equal utility, however, in indicating relative difficulties of assessment between factors.

Misidentifications result from both teams identifying the same accident cause but using different labels from the causal hierarchy. Coding errors are either errors generated by the data reducers after the causal assessment by the teams or an obvious misinterpretation of the definition of that cause by the investigator. Since only the last type of disagreements can be positively identified as bona fide errors, these errors were corrected in the process of the present analysis. As a result, all the analyses below were conducted on two data sources: the **original** data base and the **reprocessed** data base corrected for coding errors. By observing the reduction in disagreements as a result of the reprocessing we can evaluate the cost/benefit of reprocessing all cases by a person familiar with the causal hierarchy.

Results and Discussion

An overview of the results of the analysis can be obtained from the scatter plots in Figures 8-1 and 8-2. In both figures the scatter plots reflect the number of agreements, commissions/omissions, and misidentifications for each of the causal factors, listed in Table 8-1. The data in Figure 8-1 include coding errors (raw) while the data in Figure 8-2 do not

[1] Since the analysis necessitated rereading each case in order to determine which factors were confused and which were totally omitted at either level, it was too costly to re-analyze the whole in-depth file.

Figure 8-1

Comparison of Level B v. Level C Assignment of Accident Causes; Graph of Fifty (50) most Frequently Cited Causal Factors—ORIGINAL DATA

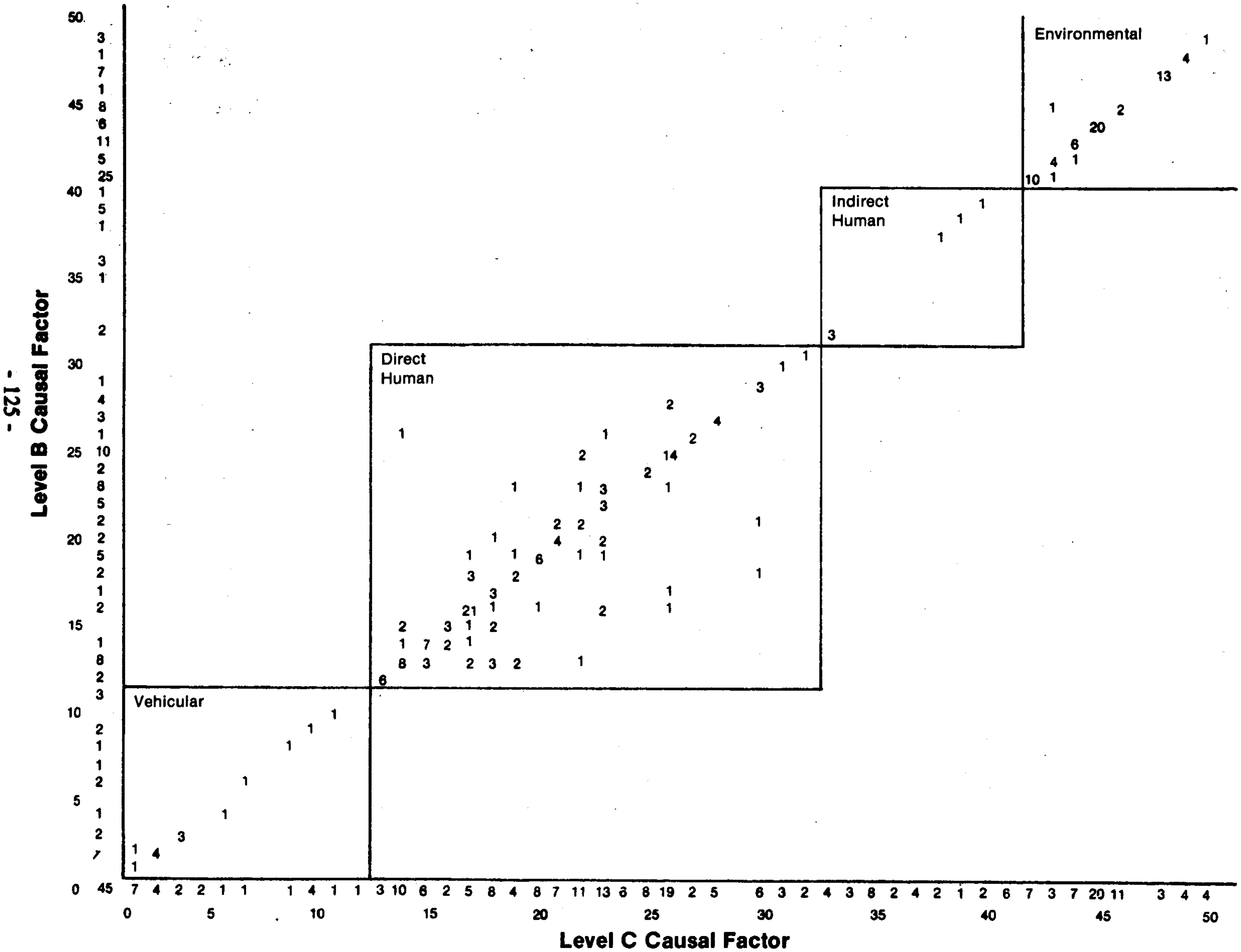


Figure 8-2

Comparison of Level B v. Level C Assignment of Accident Causes; Graph of Fifty (50) most Frequently Cited Causal Factors —REPROCESSED DATA

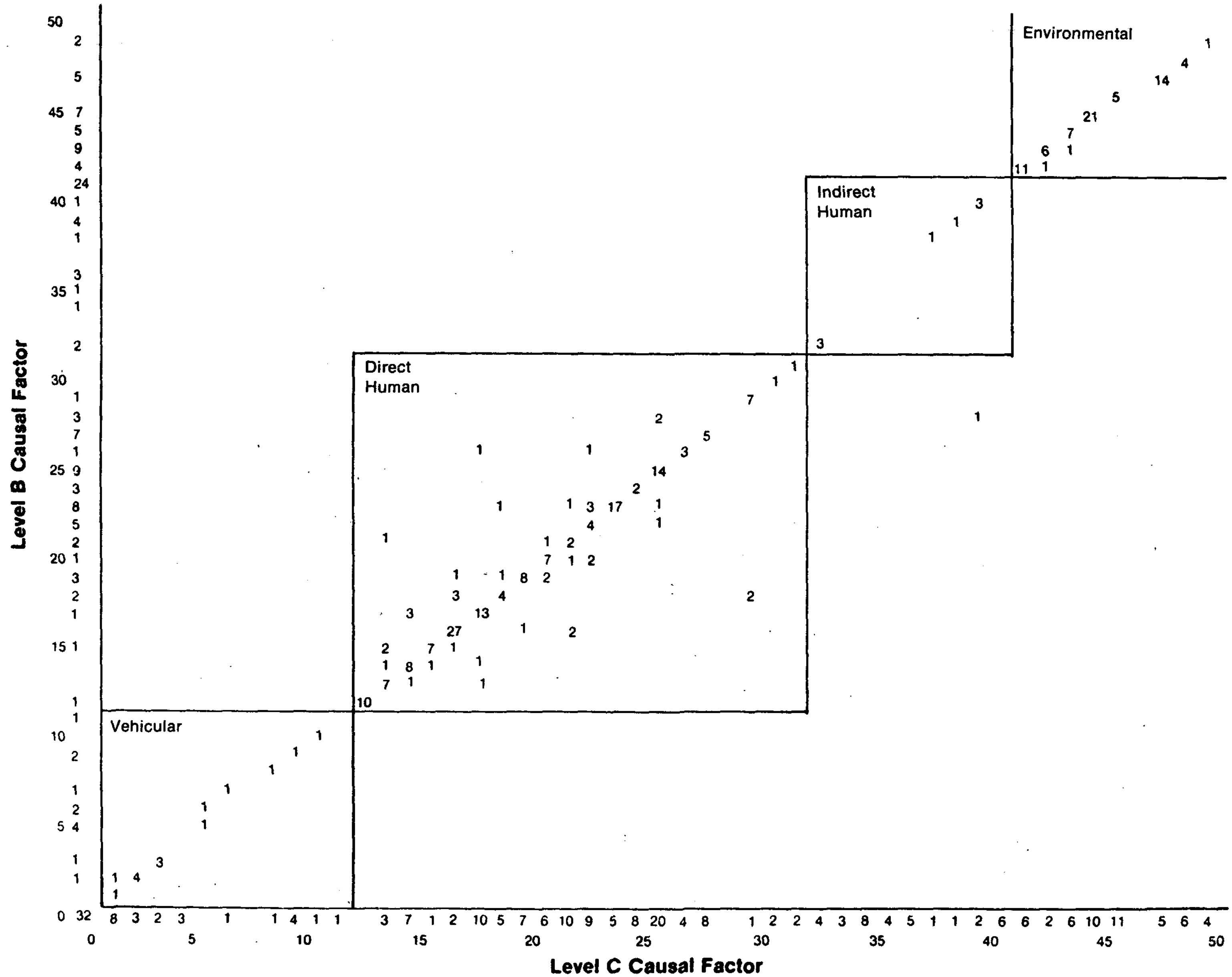


Table 8-1

The Fifty Most Frequently Cited Causal Factors Used in the B vs. C Analysis

Factor Number	Description
(00)	No Causal Factor Cited
	Vehicular Causes
(01)	Tires + Wheels—Inflation
(02)	Tires + Wheels—Other Problems
(03)	Brake System—Gross Failure
(04)	Brake System—Imbalance
(05)	Brake System—Other Performance Degradation
(06)	Steering System Problems
(07)	Suspension System Problems
(08)	Power Train + Exhaust System Problems
(09)	Communication System—Light + Signal Problems
(10)	Communication System—Other Problems
(11)	Other Vehicle Problems
	Direct Human Causes
(12)	Driver Failed to Observe + Stop for Stop Sign
(13)	Recognition Delays—Inattention
(14)	Recognition Delays—Internal Distraction
(15)	Recognition Delays—External Distraction
(16)	Recognition Delays—Improper Lookout
(17)	Recognition Delays—Other or Unknown
(18)	Decision Errors—Misjudgment of Distance/Closure
(19)	Decision Errors—False Assumption
(20)	Decision Errors—Improper Maneuver
(21)	Decision Errors—Improper Driving Technique
(22)	Decision Errors—Driving Technique Inadequately Defensive
(23)	Decision Errors—Excessive Speed
(24)	Decision Errors—Inadequate Signal
(25)	Decision Errors—Improper Evasive Action
(26)	Decision Errors—Other Errors
(27)	Performance Errors—Overcompensation
(28)	Performance Errors—Panic or Freezing
(29)	Performance Errors—Inadequate Directional Control
(30)	Performance Errors—Other Errors
(31)	Other Direct Human Causes

Table 8-1 continued

	Indirect Human Causes
(32)	Physical/Physiological—Alcohol Impairment
(33)	Physical/Physiological—Other Drug Impairment
(34)	Physical/Physiological—Other Problem
(35)	Mental/Emotional—Emotional Upset
(36)	Mental/Emotional—"In-Hurry"
(37)	Mental/Emotional—Other Problem
(38)	Experience/Exposure—Driver Inexperience
(39)	Experience/Exposure—Road/Area Unfamiliarity
(40)	Experience/Exposure—Other Problem
	Environmental Causes
(41)	Slick Roads
(42)	Highway Related—Control Hindrances
(43)	Highway Related—Inadequate Signs or Signals
(44)	Highway Related—View Obstructions
(45)	Highway Related—Design Problems
(46)	Highway Related—Maintenance Problems
(47)	Ambience Related—Special Hazards
(48)	Ambience Related—Vision Limitations
(49)	Ambience Related—Other Problems

(reprocessed data). The scale numbers on the x and y axis represent the code numbers of the causal factors (closely related factors are given contiguous numbers). The numbers in the zero row and column represent commissions/omissions. The zero column lists frequencies of on-site commissions, i.e., causes cited by the on-site investigators but not by the in-depth team. The zero row (along the abscissa) lists frequencies of on-site omissions. The disagreements will be referred to as **on-site** omissions or commissions rather than in-depth commissions or omissions since the in-depth investigation is assumed a priori to be more valid being more thorough and involving a greater depth of expertise. Technically, though, on-site omissions are identical to in-depth commissions or vice versa. Points on the diagonal indicate agreements, and points off the diagonal (but not in the zero column or row) indicate misidentifications.

Summary statistics based on the data in Figures 8-1 and 8-2 are presented in Table 8-2. Since the data are categorical (rather than ordinal or interval), nonparametric measures of association are used. The contingency coefficient (C) is a measure of relationship based on the chi-square distribution. Its major limitation is that its upper limit increases as the number of rows and columns grows—but is always less than 1.00—making interpretation difficult.

Table 8-2

On-Site/In-Depth Associations

Associations	Contingency Coefficient C	Cramer's V	Uncertainty Coefficient U
Fifty most frequent causes			
Original data with c/o[1]	.95	.44	.39
Reprocessed data with c/o	.96	.53	.47
Original data without c/o[2]	.98	.87	.81
Reprocessed data without c/o	.98	.91	.87
Human direct causes			
Original data with c/o	.96	.57	.45
Reprocessed data with c/o	.97	.67	.54
Original data without c/o	.97	.77	.76
Reprocessed data without c/o	.98	.82	.81
Human conditions and states			
Original data with c/o	.77	.45	.33
Reprocessed data with c/o	.80	.51	.39
Original data without c/o	.87	1.00	1.00
Reprocessed data without c/o	.87	1.00	1.00
Environmental causes			
Original data with c/o	.93	.59	.46
Reprocessed data with c/o	.93	.63	.48
Original data without c/o	.96	.96	.94
Reprocessed data without c/o	.96	.98	.96
Vehicular causes			
Original data with c/o	.89	.58	.44
Reprocessed data with c/o	.93	.68	.52
Original data without c/o	.94	.96	.93
Reprocessed data without c/o	.95	.97	.94

[1] Commission/Omission disagreements.
[2] Disagreements based on misidentifications only.

Cramer's V (V) is also based on chi-square but its range of possible values is $0.0 \leq V \leq 1.00$ regardless of the number of rows and columns. In the 2 x 2 case $V = \Phi$ (phi). The uncertainty coefficient (U) is based on the information theory measure of uncertainty and is defined as $= [U(y) - U(y|x)]/U(y)$ where y is the in-depth citing and x is the on-site citing. This measure of association varies from 0.0 (random associations) to 1.0 where the correlation between the two is perfect. The use of this measure is warranted because the expected value for some of the cells is small and the use of measures based on χ^2 is questionable. The major limitation of the information metric is that all disagreements are given equal weight—i.e., a misidentification is equivalent to an omission/commission. Thus, of the above three measures the uncertainty coefficient is the most conservative measure of association, and for these data, may also be considered as the most appropriate.

The frequencies of agreements and the various kinds of disagreements are presented in Table 8-3 both in absolute numbers and percentages. Note that in each column the number of disagreements or agreements for the 50 most frequently cited factors is smaller than the sum of the citings for each of the four major categories of causes. This is because the analysis for individual categories involves finer distinctions that were not included in the analyses across all factors. These are finer discriminations of inattention (4 subfactors), improper lookout (11), and view obstructions (13).

The data presented in Figures 8-1 and 8-2 and Tables 8-2 and 8-3, may be summarized as follows:

1. The raw correlations (Cramer's V) between the in-depth and on-site teams vary from .44 across all factors to .59 for environmental. When coding errors are corrected the correlations go up by an average of .07. The correspondence is greatly improved however when the omissions/commissions are excluded from the analysis: both V and U then go up to the high nineties (Table 8-2). These results indicate that while the identifications of accident causes is an illusive and subjective process, **the definitions of accident causes as used in the causal hierarchy are sufficiently specific and unambiguous.** For the reprocessed data, without commission/omission errors, the correlations between the two teams range from V = .82 for direct human causes to V = 1.00 for human conditions and states ($.81 \leq U \leq 1.00$).

2. Misidentifications are the least common type of disagreements (Table 8-3) and are typically with factors that are similar. All of the misidentifications (except for one coding error) were within the same causal class (Figures 8-1 and 8-2). These results are consistent with the conclusion above.

3. Rereading the cases for coding errors results in a reduction of the number of disagreements and an increase in the number of agreements. The benefits of this process are mostly in the areas of direct human causes and environmental causes. The increase in agreements seems to reflect a reduction in all three types of disagreements (Tables 8-2 and 8-3).

4. For all causal categories the percent of agreements is less than the percent of disagreements. It should be noted however that the probability of

Table 8-3

Frequencies of Agreements and Disagreements Between the In-Depth and On-Site Teams; Overall for the 50 most Frequently Cited Factors, and Separately for Each of the Major Causal Categories.

	Disagreements								Agreements		Total Citings	
	Misidentifications		On-Site Commissions[2]		On-Site Omissions[3]		Total					
	N	%	N	%	N	%	N	%	N	%	N	%
Fifty Most Frequent Causes Original data	58	8.5	152	22.2	243	35.5	453	66.2	231	33.8	684	100
Reprocessed	44	6.4	124	18.1	226	33.0	394	57.6	290	42.4	684	100
Human Direct (44) [1] Original	59	17.0	57	16.4	128	36.8	244	70.1	104	29.9	348	100
Reprocessed	46	13.2	43	12.4	110	31.6	199	57.2	149	42.8	348	100
Human Conditions (15) Original	0	0	13	24.5	32	60.4	45	84.9	8	15.1	53	100
Reprocessed	0	0	12	22.6	34	64.2	46	86.8	7	13.2	53	100
Environment (26) Original	3	1.5	67	34.5	59	30.4	129	66.5	65	33.5	194	100
Reprocessed	2	1.0	56	28.9	58	29.9	116	59.8	78	40.2	194	100
Vehicle (35) Original	3	5.7	13	24.5	24	45.3	40	75.5	13	24.5	53	100
Reprocessed	3	5.7	12	22.6	24	45.3	39	73.6	14	26.4	53	100

[1] Numbers in parenthesis refer to the number of different causal factors included in the analysis.
[2] Equivalent to In-Depth omissions.
[3] Equivalent to In-Depth commissions.

agreement by chance alone is small and decreases as a direct function of the total number of factors ($p \doteq \frac{1}{n}$) (Table 8-3).

5. There is a higher proportion of agreements between the on-site and in-depth teams on environmental and direct human causes than on human conditions and vehicular causes (Table 8-3).

6. Of the disagreements, the most predominant are on-site omissions, particularly in the area of human states and conditions. The tendency to omit rather than commit accident causes indicates more conservative judgments and is a positive bias in light of the on-site team's poorer data quality (Table 8-3).

The accident causal hierarchy, as assessed by the above analyses, seems to provide a better scheme than the Accident Causation Analysis System (ACAS) that was only recently evaluated by Marsh (1975). Using the ACAS scheme the agreement between three coders working independently was only 4% for the human direct causes and 9% across all causes while the TAC scheme produced an agreement rate of 30% and 24% respectively (for strict comparisons the agreement rate for two ACAS coders is needed but this statistic is unavailable). Furthermore, the greatest difference between the TAC and ACAS schemes may be in the type of errors they are susceptible to. According to Marsh (p. 21) "A few minor causal factors hidden in the case text may have been missed, but all coders were in general agreement about what the original team intended to imply in their case documentation. The problem frequently came in trying to express the case contents in the ACAS scheme. This probably occurred because of misinterpretation of how the ACAS factors should be applied (i.e., which factor to use in each situation), and because the team documentation did not have an orientation consistent with the ACAS." In the present analysis the "factors missed" are the omissions/commissions, and the "misinterpretations" are coded as misidentifications. Thus with the TAC system a reverse trend is noted: most disagreements are due to omission/commission errors rather than misidentifications. One explanation is that the TAC hierarchy is probably more rigorously defined and amenable to consistent classification by experienced accident investigators. Another explanation comes from the fact that omission/commission errors are less likely as the number of causes cited increases. The causal analysis procedures of the TAC Study are more rigorous and the citings are more conservative as indicated by a smaller average number of causal citings per case (here Level B = 3.1, C = 4.0; ACAS = 6.7). Marsh (p. 20) too notes that the number of misidentifications increases directly with the number of factors cited.

8.2 Evaluation of Level B Causal Assessments

The justification for evaluating the on-site team's performance on the basis of the degree of correspondence between their assessment and the in-depth's is based on the fact that the in-depth team has the advantages of (a) being composed of more highly trained experts, (b) having a much more detailed account of the accident and (c) having at their disposal both the on-site case report (which might contain information that was not available later at the time of the in-depth investigation) and the in-depth data. For these reasons it is more likely that the in-depth causal assessment is more valid than the on-site. Perhaps the major shortcoming of the in-depth assessment is that it is based on a post-hoc analysis (i.e., the accident has already occurred), and as such it is subject to various biases (Fischoff, 1974; Loftus and Palmer, 1974; Walster, 1966). However, as noted in the beginning of this section, in the absence of an independent and valid causal analysis, the in-depth causal assessment is at best a close approximation to the truth.

A decision theory approach to evaluating the on-site assessment is used in which the in-depth's assessment is taken to reflect the true state of the world. A methodology typically associated with Signal Detection Theory (SDT) is then used to determine the α and β error levels of the on-site team, and some indices based on these error rates are derived. The SDT approach will be briefly described below; a more extensive treatment of the SDT analytical approach and rationale is available in Green & Swets (1966).

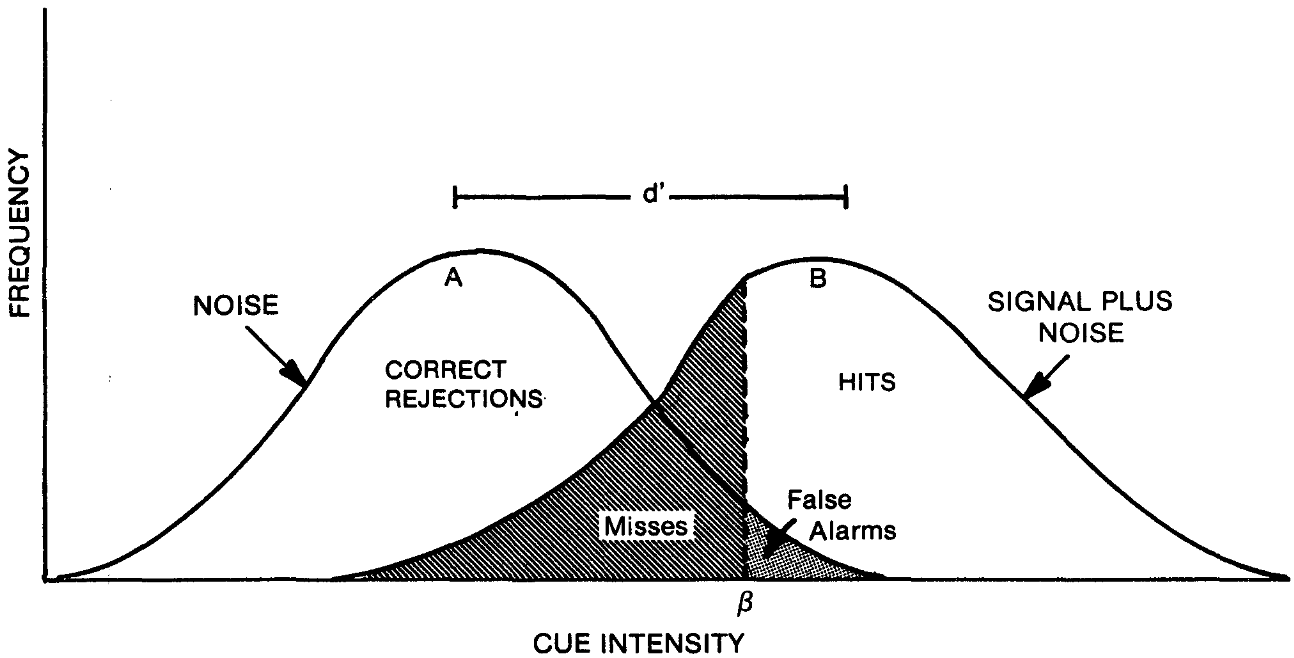
According to SDT when an event (signal) occurs in the outside world it gives rise to a change in the person exposed to it. However whether this change in the situation will be detected or not is a function of two different phenomena: (a) The extent to which the signal is stronger than the general "noise" in the system and (b) The bias or risk-taking level that the person has with respect to stating the signal is there when in fact it is not (α type error). Each of the above phenomena can be quantified as will be illustrated below.

For the purpose of this illustration let us examine on-site's performance in correctly identifying the environmental factor "control hindrances" (Factor No. 42 in Table 8-1, and Figures 8-1 and 8-2). We can then depict the factor detection process as shown in Figure 8-3. In this figure curve A is the frequency distribution of the "strength of evidence," or intensity of control hindrance cues, when it is **not** a causal factor. Curve B is the frequency distribution of the same cues when control hindrance **is** a causal factor. Typically the two curves will overlap and the investigator then is assumed to have (not necessarily consciously) a criterion (β in Figure 8-3) so that whenever the signal intensity exceeds β he identifies control hindrance as a causal factor and whenever the signal intensity is less than β he decides that the "signal" is not present, i.e., control hindrance is not a factor. The location of β on the cue intensity (χ) axis represents the bias the investigator has in terms of the relative proportion of **missing** a factor when it is causal (misses) and citing a factor when in fact it should not be cited (false alarms). The conditional probabilities of misses and false alarms can be derived from a frequency table and formulas such as those in Table 8-4 in which the numerical values are those obtained for control hindrance (Factor 42 in Table 8-5). In the case of control hindrance P (hit) = .67 and P (False Alarm) = .024. Note that for the area marked "misses" in Figure 8-3, P (Miss) = 1 - P (Hit).

Obviously it would be most desirable to both maximize the hits and minimize the false

Figure 8-3

A Signal Detection Theory (SDT) Representation of the Detection of Causal Factors. (See text for explanations.)



alarms. However, since this cannot be done, an alternative objective is to maximize the quantity P (Hit) - β P (False Alarm), where β is a constant. A decision rule that maximizes this quantity is to cite the presence of a factor (in this case control hindrance) if and only if the likelihood ratio (LR) below is greater than β:

$$LR = \frac{f\ (\text{Hits})}{f\ (\text{False Alarms})} > \beta$$

where f (Hits) is the value of the ordinate of curve B at β and f (False Alarms) is the value of the ordinate of curve A at β.

The LR is a statistic that enables us to evaluate on-site's performance in terms of both hits and false alarms. In the case of control hindrance, where LR = 7.49, for every false alarm, the

Table 8-4

In-Depth and On-Site Frequency Tabulations and Signal Detection Statistics Derivable from These Frequencies (The numerical values are used to illustrate the derivation of the SDT statistics for the Control Hindrance Factor).

On-Site Citings	In-Depth Citings Yes	No	Total
Yes	$O_Y I_Y = 6$ Hits	$O_Y I_N = 5$ False Alarms	$O_Y = 11$
No	$O_N I_Y = 3$ Misses	$O_N I_N = 204$ Correct Rejections	$O_N = 207$
Total	$I_Y = 9$	$I_N = 209$	$T = 218$

From this table we can then derive the following conditional probabilities:

$P\ (\text{Hit}) = P\ (O_Y|I_Y) = P\ (O_Y,I_Y)/P\ (I_Y) = O_Y I_Y/I_Y$

$P\ (\text{False Alarm}) = P\ (O_Y|I_N) = P\ (O_Y,I_N)/P\ (I_N) = O_Y I_N/I_N$

where I denotes in-depth
O denotes on-site
Y denotes citing a factor
N denotes not citing a factor

on-site team is likely to cite control hindrance correctly 34 times! Evaluation of on-site's performance based on either factor alone could be very misleading. Thus, the knowledge that a control hindrance is inappropriately cited only 2.5% of the times does not reveal that 33% of the time a control hindrance is completely missed [(1 - P (hits)].

The likelihood ratio should reflect the values and costs associated with hits and false alarms, and when these can be quantified, a procedure to adjust LR is available (see Green and Swets, 1966, p. 21).

In the analysis of on-site's ability to detect causal factors, another variable is the distance between the "noise" and "signal plus noise" distribution (A and B in Figure 8-3). This distance, labeled d', denotes the discriminality of the signal, the "obviousness" of the factor (when it is present), or the discriminating capacity of the on-site team independent of where its criterion β is. **If we assume that both signal and noise are normally distributed and have equal variance,** then from the P (Hit) and P (False Alarm) we can determine the value of β (LR) the distance of the criterion point from the means of the two distributions, and hence the distance between the two distribution means (in standard scores)[2]. The greater the d' the more detectable the factor is. In the case of control hindrance d' = 2.42. This means that if the on-site team would give equal value to misses and false alarms—shifting their criterion β accordingly—then the probability of either error would be $P(Z \geq d'/2) = .11$, i.e., any reduction in the rate of misses would be costly in terms of the increase in false alarms, but in any case the lowest error rate possible, given that level of d', is 11% of each of the error types (false alarms and misses), or 22% total errors. For convenience sake in the discussion below a factor will be considered as adequately discriminable by on-site whenever d' > 2.0, i.e., whenever the total minimum possible error rate < 31%.

In the remainder of this section, on-site's performance on each of the factors will be evaluated in terms of the SDT statistics P (hit), P (false alarm), LR, and d'. These are summarized in Table 8-5 for the fifty most frequently cited factors. Before proceeding to a more detailed discussion in terms of the four major categories of causal factors, human direct causes, human states and conditions, environmental causal factors and vehicular causes, several general comments are in order.

1. The use of conditional, rather than unconditional, probabilities is helpful in reducing effects caused by variations in the frequencies of occurrence of the factor (in this case, variations in I_Y and I_N). Nonetheless, the small frequencies obtained for many of the factors make the stability of the SDT estimates questionable. In light of the great potential of this analysis it is recommended that it be extended to all the in-depth cases.

2. For all factors, on-site investigators tend to be conservative in their estimates, the probability of a miss being always greater than the probability of a false alarm. While this criterion trade-off is good since it reduces the likelihood of pursuing wrong alleys in future accident prevention attempts, the high miss ratios do have three major shortcomings: a) it increases the likelihood that critical accident causes will be overlooked; b) it may introduce a bias in estimating the relative frequencies of different causal factors, since the miss rate is not the same for all factors; and c) it increases the real cost of on-site investigation when viewed as a function of causal factors detected rather than accidents covered.

3. The relatively low hit rate for most factors probably reflects on-site's practical limitations in terms of the time available for the investigation, and the size and expertise of the team.

[2] A recent analysis by Frank (1977) indicates that the β and d' estimates are fairly stable across a wide range of different biases, different underlying distributions, and different variance ratios, as long as the Hit rate is relatively high.

4. The likelihood ratios are fairly high for all factors for which the $O_Y I_Y$ and $O_Y I_N$ are greater than zero. These high ratios again reflect on-site's conservative attitude (low false alarm rate), and in and of themselves are indicators of good performance.

5. Across all causal factors the hit rate is close to 50% and the false alarm is less than 2%. The d' based on those estimates is 2.06, indicating that if on-site were to shift their criterion so as to minimize the absolute number of errors [P (false alarm) = P (misses)] the error rate of both types of errors combined would be 30%.

6. Of the major causal categories, direct human causes are the easiest to detect (d' = 2.05) and human conditions and states are the most difficult (d' = 1.44). In the case of human conditions and states this is due to the very low average hit rate [P (hit) = .19].

7. Within each of the major categories there are wide variations in on-site's ability between the different individual factors. This finding is very significant since it suggests that blanket statements that on-site investigation is adequate for, say, environmental factors but not human conditions and states, are a gross oversimplification. The variations between factors are also useful in pointing out areas where on-site investigators may benefit from more training.

8. **On-site teams are very good at assessing nonculpability [P (Hit) = .84, LR = 1.81, see row 1 of Table 8-5]. Apparently this is one of the more clear-cut situations, yielding a d' = 2.46.**

Vehicular Causes

As a group, vehicular causes should be expected to be the most amenable to detection, since they are the easiest to quantify. The inherent limitations of on-site investigations are most obvious here: Factors associated with gross or easily observable failures are relatively easy to detect (d' $>$2.0), while others are very difficult to detect (d' $<$1.5) with no factors in between.

Vehicular factors to which on-site is not sensitive at all are tire inflation problems (Factor number 1), imbalanced brakes (4), suspension problems (7) and possibly communication systems (9). These factors are both hard to observe without tools and additional time and are most likely not noticed by the drivers either, so they remain undetected in the brief interview.

Factors that are easily detected by the on-site team are other tire and wheel problems (2), gross brake failure (3) or degradation (5), and steering problems (6). However, even for these factors approximately 50% of the cases detected by the in-depth team are expected to remain undetected by the on-site team.

Table 8-5

On-Site's Ability to Detect Each of the Causal Factors Relative to In-Depth's Performance (For Explanation of Cell Entries see text).

	Cell Frequencies				SDT Statistics			
Factor No.	O_Y,I_Y	O_YI_N	I_Y	I_N	P (Hit)	P (False Alarm)	LR	d'
No Citing 0	32	11	38	169	.84	.07	1.81	2.46
VEHICULAR CAUSES								
1	1	0	10	208	.10	.00	—	—
2	4	2	7	211	.57	.01	14.75	2.50
3	3	1	5	213	.60	.01	14.51	2.58
4	0	1	3	215	.00	.01	—	—
5	1	4	2	216	.50	.02	8.25	2.05
6	1	2	2	216	.50	.01	14.98	2.32
7	0	1	0	218	.00	.01	—	—
8	1	0	2	216	.50	.00	—	—
9	1	2	5	213	.20	.01	10.52	1.48
10	1	0	2	216	.50	.00	—	—
11	0	1	1	217	.00	.01	—	—
Average	1.18	1.27	3.55	214.45	.33	.01	13.60	1.88
HUMAN DIRECT CAUSES								
12	10	1	10	208	1.00	.01	—	—
13	7	2	14	204	.50	.01	14.98	2.32
14	8	3	19	199	.42	.02	8.08	1.85
15	7	4	9	209	.78	.02	6.12	2.82
16	27	3	34	184	.79	.02	5.96	2.86
17	13	4	26	192	.50	.02	8.25	2.05
18	4	7	11	207	.36	.03	5.50	1.52
19	8	7	16	202	.50	.04	4.63	1.75
20	7	4	16	202	.44	.02	8.15	1.90
21	2	4	16	202	.13	.02	4.37	.92
22	4	6	19	199	.21	.03	4.24	1.08
23	17	14	22	196	.77	.07	2.26	2.20
24	2	3	10	208	.20	.01	10.52	1.49
25	14	9	38	180	.37	.05	3.66	1.31
26	3	3	7	211	.43	.01	14.75	2.15
27	5	2	13	205	.38	.01	14.30	2.02
28	0	6	0	218	.00	.03	—	—
29	7	1	10	208	.70	.01	13.06	2.85
30	1	0	3	215	.33	.00	—	—
31	1	0	3	215	.33	.00	—	—
Average	7.35	4.15	14.8	203.1	.50	.020	8.25	2.05

Table 8-5 continued

	Factor No.	O_Y, I_Y	$O_Y I_N$	I_Y	I_N	P (Hit)	P (False Alarm)	LR	d'
		Cell Frequencies				SDT Statistics			
HUMAN— CONDITIONS & STATES	32	3	2	7	211	.43	.01	14.75	2.14
	33	0	0	3	215	.00	.00	—	—
	34	0	1	8	210	.00	.01	—	—
	35	0	1	4	214	.00	.01	—	—
	36	0	3	5	213	.00	.01	—	—
	37	1	0	2	216	.50	.00	—	—
	38	1	1	2	216	.50	.01	14.98	2.32
	39	3	4	6	212	.50	.02	8.25	2.08
	40	0	1	6	212	.00	.01	—	—
	Average	0.89	1.44	4.78	213.22	.19	.01	10.19	1.44
ENVIRONMENTAL CAUSES	41	11	25	17	201	.65	.12	1.85	1.53
	42	6	5	9	209	.67	.02	7.49	2.49
	43	7	9	14	204	.50	.04	4.63	1.75
	44	21	5	39	179	.54	.03	5.84	2.01
	45	5	7	16	202	.31	.04	4.10	1.26
	46	0	0	0	218	.00	.00	—	—
	47	14	5	19	199	.74	.03	4.77	2.52
	48	4	0	10	208	.40	.00	—	—
	49	1	2	5	213	.20	.01	10.52	1.48
	Average	7.67	6.44	14.33	203.67	.54	.03	5.84	1.95
Grand Mean		4.84	3.43	10.35	207.61	.47	.02	8.22	1.98

Power train/exhaust system problems (8) and communication problems other than lights were too rare in this sample to be properly assessed.

Human Direct Causes

Human direct causes, in a sense, are the most difficult to assess. This is because often the sole source of evidence is the driver's own report (e.g., inattention). In addition to motivational biases (e.g., social desirability) a quickly decaying memory affects **both** the "immediate" recall on-site and the delayed recall later during the in-depth interview. The major shortcomings of the on-site report are fear of self-incrimination (the police are often still around), memory blocking due to the situational stress (retrograde amnesia), and lack of interviewing time and expertise on the part of the investigator. The major shortcomings of the in-depth interview are the forgetting and restructuring of events to suit the driver's self image as a careful driver. However, as in the rest of this section the assumption behind all the arguments below is that the in-depth conclusions are valid.

The human causes that can be said to be highly detectable on the accident scene are failing to observe and stop for a stop sign (12), external distractions (15), improper lookout (16), and inadequate directional control (29), all yielding d' >2.80. For all three causes the hit rate is also >70%, suggesting that both on-site's sensitivity and their cut-off criterion (β) is proper.

Other factors for which an on-site investigation may be considered adequate are inattention (13), recognition delays other than internal distraction (17), excessive speed (23), and overcompensation (27). At present, of the above only excessive speed is discovered sufficiently often [P (Hit) = .77]. The others yield a hit rate of .50 or less. Since these factors are potentially detectable (based on d' > 2.0) on-site's performance here can be improved by training them to shift their criteria (to the left in Figure 8-3) so they would be less conservative.

Factors that are definitely too difficult for on-site to detect (d' <1.5) are misjudgment of distance (18), improper driving technique (21), inadequate defensive driving (22), inadequate signalling (24), and improper evasive action (25). For these factors, a shift in the criterion to increase the low hit rate (<36%) will not be very helpful since the distance between the two curves (d' A and B in Figure 8-3) is already too small. In addition, on-site are apparently too ready to cite panic or freezing (28) as a causal factor when in fact it is probably not causal. This may be a halo effect of talking to the still excited driver. Their ability to detect it when it is there cannot be determined since it was not cited by in-depth at all in this sample (l_Y =O).

Factors which are marginally detectable by on-site (1.5< d'<2.0) are internal distraction (14), false assumption (19), and improper maneuver (20). Performance on these factors can be improved by a criterion shift to raise the hit rate and perhaps also by improving the interviewing skills (and thus raise the d').

Human Conditions and States

The data base for this category is the smallest of all four: In this sample human conditions and states were cited by the in-depth team only 13 times. The pattern here seems similar to that observed for vehicular factors. A factor is either easily detectable or almost not at all. Those factors that are relatively easy to detect are alcohol impairment (32), driver inexperience (38) and area unfamiliarity (39). In all cases, however, it might be well to adjust the decision criterion in order to raise the hit rate.

Factors that cannot be expected to be detected by the on-site investigators are physical/physiological impairment and mental/emotional stress (33, 34, 35, 36, 37). Only an in-depth interview, sometimes coupled with contact with a physician, can reveal these factors.

Environmental Causes

Environmental causes, like human direct causes, are represented by a wide range of d's, corresponding to a wide range of detectability. Here the on-site advantage is in the ability to observe transient cues that often disappear by the time the in-depth investigator arrives (e.g., skid marks, POI evidence, glass on road, etc.). On the other hand, on-site does not have the time or skill to perform the more exacting accident reconstruction task that often involves speed/distance calculations.

The factors that can be considered detectable by on-site are control hindrances (42), view obstructions (44) and special hazards (47). Of these the hit rate of detection of view obstructions can and should be raised by shifting β and increasing the false alarm rate. Ambience related vision limitation (48) may also belong to this category, though the data base in insufficient.

Factors that probably cannot be adequately detected on-site are slick roads (41), inadequate signs or signals (43), and highway design problems (45). Slick roads as a causal factor is a good illustration of the need for a more in-depth, quantifiable, data analysis.

In summary the SDT analysis of on-site's performance appears to be very beneficial in at least two areas:

1. Determining what kind of accident causes can be adequately assessed by this study's type of on-site teams, and conversely, what type of accident causes require a more expert and in-depth effort.

2. Where on-site team is inadequate, the breakdown of errors into misses and false alarms, the case of the d' statistic, allows a further assessment regarding possible methods of improving the on-site team's performance through retraining, criterion-shift, etc.

Finally, prior to any implementation of the conclusions derived from the results above, some of the SDT assumptions should be verified on the accident causes data base (e.g., normality of cue for each accident cause). Furthermore, for those causes in which the absolute frequency of citings by the in-depth team was very low more data should be gathered (e.g., factor 38), since it may change the SDT statistics dramatically.

9.0 Representativeness of Study Samples and Study Area

The purpose of this section is to evaluate the national representativeness of IRPS on-site and in-depth accident samples and to determine the effects of non-representative sampling on causation results. Analyses are divided into three sections. The first (section 9.1) assesses the national representativeness of licensed driver, registered vehicle, roadway and police reported study area statistics. The second (section 9.2) assesses the study area representativeness of on-site and in-depth samples. Both phase V and combined phases II through V data sets are evaluated. The third (section 9.3) identifies accident configuration characteristics which are related to accident causation and assesses the effects of nonuniform sampling (with respect to these characteristics) on IRPS on-site accident causation statistics. Terms used above and in the sequel are defined as follows:

Study area	—	Monroe County, Indiana
Exposure	—	Characteristics of study area and national licensed driver, registered passenger vehicle and roadway populations.
Police reported	—	Study area and national traffic accident data reported to state level police agencies.
Baseline	—	Police reported and exposure data.
On-Site	—	Traffic accident data collected by IRPS on-site level accident investigation teams.
Biasser	—	Characteristics of drivers, vehicles, roadways or accidents known or believed to be correlated with factors which cause or increase the severity of traffic accidents.
Representativeness	—	The process of identifying biassers and determining if samples are stratified with a uniform sampling fraction with respect to each biasser.

9.1 National Representativeness of the Study Area

Representativeness of the study area is assessed by comparing baseline biasser characteristics of Monroe County, Indiana with the nation. Biassers selected for comparison are classified into two groups—exposure and police reported. Exposure biassers give an indication of the representativeness of study area roadway, licensed driver and registered passenger vehicle populations, while police reported biassers give an indication of study area accident configuration representativeness. Table 9-1 summarizes results for each selected biasser. Maximum percentage, categorical differences between the study area ($n_i/n \times 100$) and the nation ($p_i/p \times 100$) are presented along with appropriate biasser class labels and Appendix C table numbers. Negative percentage differences indicate the study area is

Table 9-1

Summary of the National Representativeness of the Study Area

	Biasser	Difference of Percentages for Most Variant Category $\text{Max}\left\{\frac{n_i}{n} - \frac{p_i}{p}\right\} \times 100\%$	Largest Biasser Category	Appendix C Table No.
EXPOSURE	Vehicle Model Year	.8	1971	C-1
EXPOSURE	Driver Sex	3.1	Females	C-2
EXPOSURE	Vehicle Make	-3.6	Chevrolet	C-3
EXPOSURE	Driver Age	11.6	20-24	C-4
EXPOSURE	Road and Street Mileage	17.8	Surfaced County Roads	C-5
POLICE REPORTED	Hour of Accident	.8	Noon to 3:59 p.m.	C-6
POLICE REPORTED	Vehicle Type	2.4	Passenger Vehicles	C-7
POLICE REPORTED	Driver Sex	4.5	Female	C-8
POLICE REPORTED	Place of Accident Occurrence	5.0	Rural	C-9
POLICE REPORTED	Light Conditions	6.2	Daylight	C-10
POLICE REPORTED	Type of Accident	7.7	Collision with other motor vehicle	C-11
POLICE REPORTED	Condition of Road Surface	8.0	Wet	C-12
POLICE REPORTED	Driver Age	9.2	20-24	C-13
POLICE REPORTED	Accident Severity	15.1	Property Damage	C-14

n_i—Study area frequency count for category i
n —Total study area observations
p_i—National frequency count for category i
p —Total national observations

National Data Sources: Vehicle model year, vehicle make—R.L. Polk and Company, 1974; road and street mileage—Highway Statistics, 1973; licensed driver age and sex,

Table 9-1 continued

	vehicle type, accident-involved driver age and sex, place of accident occurrence, condition of road surface—Accident Facts, 1974 edition; light conditions, type of accident and accident severity—National Accident Summary File, 1972 Statistics.
Monroe County Data Sources:	Vehicle model year, vehicle make—R.L. Polk and Company, 1974; road and street mileage—Indiana State Highway Commission (Planning Division) 1968 Road Inventory; licensed driver sex and age—1974 Monroe County driver's license applications; police reported data—1974 Indiana State Police Accident Data.

underrepresented with respect to that biasser category; positive differences indicate an overrepresentation. Detailed study area/national comparisons are presented in Tables C-1 thru C-14 in Appendix C. Data sources used are (1) *Accident Facts*, 1974 Edition; (2) R.L. Polk and Company—1974 statistics; (3) Monroe County License Branch—1974 driver license applications; (4) Indiana State Highway Commission (Planning Division)—1968 Road Inventory; (5) Highway Statistics, 1973; (6) 1974 Indiana State Police Accident data; (7) National Accident Summary file 1972 Statistics.

Exposure Data

Table 9-1 shows Monroe County is representative of the nation with respect to vehicle model year—slight over-representation of 1971 vehicles (.8%), driver sex—slight overrepresentation of females (3.1%), and vehicle make — a slight underrepresentation of Chevrolets (-3.6%).

As in the past, Monroe County continues to have more drivers in the 20-24 year old class (and proportionally fewer older drivers) than the nation. This overrepresentation has had the effect of overrepresenting 20-24 year old drivers in the study area accident population and, in turn, in on-site and in-depth samples. The effect of over and under sampling age substrata is that IRPS accident causation results can misrepresent the national picture. This problem is addressed in section 9.3.

With respect to road and street mileage by system and type of surface, Monroe County has 17.8% more surfaced county roads than the nation. This is caused by an overrepresentation of county roads and a corresponding underrepresentation of state and U.S. highways. Over all systems (county, municipal, state and U.S.), Monroe County is overrepresentated with respect to surfaced roads (5.8%) and correspondingly underrepresented with respect to non-surfaced roads. In addition, Monroe County does not contain a limited access multi-lane highway.

Police Reported Data

Table 9-1 summarizes the national representativeness of the study area with respect to selected traffic accident characteristics. Individual comparisons (Monroe County with the nation) are presented in Appendix C, Tables C-1 thru C-14.

Monroe County accidents are shown to be representative of the nation with respect to hour of accident—slightly overrepresented with accidents in the noon to 3:59 p.m. time period (.8%) and vehicle type—a slight overrepresentation of passenger vehicles (2.4%).

Female drivers are overrepresented in Monroe County accidents. Females are overrepresented because Monroe County women drive more than their national counterparts, thus increasing their likelihood of accident involvement (reference 1). This overrepresentation of women in the study area/police-reported accident population has resulted in an overrepresentation of females in both on-site and in-depth samples.

Monroe County accidents are overrepresented with rural accidents. This is because of the predominantly non-industrial nature of the county. This overrepresentation has contributed to the overrepresentation of rural accidents in both on-site and in-depth samples.

Monroe County accidents are overrepresented with daylight accidents. This is probably because of the absence of a large metropolitan/industrialized area in Monroe County which would generate more after dark traffic.

Monroe County is overrepresented with multiple vehicle accidents and correspondingly underrepresented with collisions with pedestrians, collisions with non-motor vehicles and collisions with fixed objects.

Accidents in Monroe County occur more often on wet road surfaces (and correspondingly less on dry roads) than national accidents.

With respect to driver age, Monroe County accident-involved drivers are overrepresented with 20-24 year old drivers and underrepresented with drivers 35 years and older. This is because of the presence of a large state university.

Monroe County police-reported accidents are overrepresented with property damage accidents when compared with national estimates. This is because of differences between Indiana and other states with respect to the legal requirements for reporting property damage accidents. Dependent upon the state, legal requirements vary from necessity for towing one vehicle from the scene to damage amounts ranging from $400 to $25. Indiana requires an accident report be filed with the state if damage amounts to at least $100.

Summary

Exposure biassers fall into two classes: (1) biassers which are represented appropriately in the study area—driver sex, vehicle model year and vehicle make, and (2) biassers for which Monroe County is not representative of the nation—driver age and road and street mileage. The Monroe County driving population is overrepresented with 20-24 year old drivers. Monroe County is overrepresented with surfaced county roads and underrepresented with limited access, multi-lane highway.

Police reported biassers represented appropriately in the study area are hour of accident and type of accident-involved vehicle. Biassers not represented properly are place of accident occurrence (an overrepresentation of rural accidents), light conditions (an overrepresentation of daylight accidents), type of accident (an overrepresentation of collisions with other motor vehicles), condition of road surface (an overrepresentation of accidents which occur on wet roads), driver age (an overrepresentation of 20-24 year old drivers) and accident severity (an overrepresentation of property damage accidents).

9.2 Study Area Representativeness of On-Site and In-Depth Samples

Phase V

In order to assess the study area representativeness of on-site and in-depth samples, biasser characteristic distributions of Phase V on-site and in-depth samples were compared with the population of 1974 Monroe County Police reported accidents. Tables 9-2 and 9-3 summarize the results of this analysis. Maximum category percentage differences, appropriate biasser category tables, chi-square, one-sample significance levels and Appendix C table reference numbers are presented for each biasser. Accident characteristic biassers are listed in descending order of representativeness followed by driver/vehicle biassers—ranked in the same manner. Detailed Monroe County on-site, in-depth comparisons for each biasser are presented in Appendix C, Tables C-15 through C-30.

Table 9-2 indicates that Phase V in-depth accidents are representative of the study area with respect to most biassers. No detectable systematic selection bias exists for light conditions, weather conditions, month of accident, urban and rural places, severity of accident, road surface condition, character of location, arrest, vehicle type and driver sex.

Statistically significant differences do exist for six of sixteen biassers—hour of accident, day of week of accident, accident type, investigation source, type of driver's license and driver age. The Phase V in-depth sample is overrepresented with accidents which occur in the morning (8:00 a.m. to 11:59 a.m.) and underrepresented with accidents which occur in the evening and early morning (8:00 p.m. to 7:59 a.m.). The in-depth sample is overrepresented with weekday and underrepresented with weekend accidents. The Phase V in-depth sample is also overrepresented with non-collision/running off the road type accidents. Because IRPS investigates only accidents reported by sheriff, state and city police agencies, the in-depth sample contains no accidents which have been reported by private individuals. These comprised 26.8% of reported Monroe County accidents in 1974. With respect to driver license type and driver age, the Phase V in-depth sample is overrepresented with non-residents licensed outside of the state and drivers 20-24 years of age.

Table 9-3 shows statistically significant differences exist for eight of the sixteen biassers for the on-site sample. This increase in significant differences from in-depth results is partially due to a larger on-site sample (by increasing sample sizes, the chi-square one-sample test automatically reduces the level of sample/theoretical distribution differences required to reach a designated level of significance).

The Phase V, on-site sample is not subject to systematic selection bias for eight of the selected measures. These are urban and rural places, light conditions, month of accident, day

Table 9-2

Summary of the Study Area Representativeness of the Phase V In-Depth Sample

Biasser	Difference of Percentages for Most Variant Category $Max\left\{\frac{Ii}{I} - \frac{ni}{n}\right\} X\ 100\%$	X^2 Significance	Largest Biasser Category	Appendix C Table No.
Light Conditions	2.5	NS	Daylight	C-16
Weather Conditions	2.8	NS	Raining	C-19
Month of Accident	3.2	NS	Jan-March	C-17
Urban and Rural Places	3.4	NS	Urban Area	C-15
Severity of Accident	-3.5	NS	Property Damage	C-21
Road Surface Condition	-4.0	NS	Snowy or Icy	C-22
Character of Location	8.5	NS	Intersection	C-24
Hour of Accident	11.0	*	8:00 a.m. to 11:59 a.m.	C-20
Day of Week	8.7	**	Tuesday	C-18
Accident Type	19.1	***	Other non-collision, running off the road	C-23
Investigation Source	-26.8	***	Was not investigated	C-25
Arrest	-1.2	NS	Arrested for Other Violation	C-28
Vehicle Type	4.4	NS	Passenger Vehicle	C-30
Driver Sex	5.1	NS	Female	C-26
Driver's License	4.4	*	Non-resident	C-29
Driver Age	16.2	**	20-24	C-27

* $p \leq .05$ **Ii —In-depth sample frequency count for category i**
** $p \leq .01$ **I —Total in-depth sample observations**
*** $p \leq .001$ **ni—Study area frequency count for category i**
NS Not Significant **n —Total study area observations**

Data Sources: IRPS—Phase V in-depth sample; Monroe County—1974 ISP data.

Table 9-3

Summary of the Study Area Representativeness of the Phase V On-Site Sample

Biasser	Difference of Percentages for Most Variant Category $Max\left\{\frac{o_i}{o} - \frac{n_i}{n}\right\} X\ 100\%$	X^2 Significance	Largest Biasser Category	Appendix C Table No.
Urban and Rural Places	.8	NS	Rural	C-15
Light Conditions	1.0	NS	Darkness	C-16
Month of Accident	1.1	NS	Oct-Dec	C-17
Day of Week	2.4	NS	Saturday	C-18
Weather Conditions	3.7	NS	Clear	C-19
Hour of Accident	4.3	**	Noon to 3:59 p.m.	C-20
Severity of Accident	-4.4	**	Property Damage	C-21
Road Surface Condition	5.9	***	Dry	C-22
Accident Type	7.9	***	Other non-collision, running off the road	C-23
Character of Location	11.6	***	Intersection	C-24
Investigation Source	-26.8	***	Was not investigated	C-25
Driver Sex	1.3	NS	Male	C-26
Driver Age	2.3	NS	20-24	C-27
Arrest	3.8	NS	Driver not Arrested	C-28
Driver's License	-.9	**	Licensed in State	C-29
Vehicle Type	.9	***	Motorcycles	C-30

* $p \leq .05$ — o_i—On-site sample frequency count for category i
** $p \leq .01$ — o —Total on-site sample observations
*** $p \leq .001$ — n_i—Study area frequency count for category i
NS Not Significant — n —Total study area observations

Data Sources: IRPS—Phase V on-site sample; Monroe County—1974 ISP Data.

of week of accident, weather conditions, driver sex, driver age and driver arrest status.

Systematic selection bias for the Phase V on-site sample does exist for **severity of accident**—underrepresented with property damage and overrepresented with personal injury accidents; **road surface condition**—overrepresented with dry and underrepresented with wet, snowy/icy road surface conditions; **accident type**—overrepresented with non-collision/running off the road and underrepresented with collision with fixed objects and collision involving other object or animal type accidents; **character of location**—overrepresented with intersection and underrepresented with "open road" accidents; **investigation source**—includes only accidents reported by state, sheriff or city police agencies; **driver's license**—slightly underrepresented with licensed in-state drivers and overrepresented with non-licensed state residents; **vehicle type**—slightly overrepresented with motorcycles and underrepresented with buses.

Phases II, III, IV and V

Accident characteristic (biasser) distributions of Phases II, III, IV and V on-site and in-depth samples were compared with combined 1972, 1973 and 1974 study area statistics. This was done to assess the study area representativeness of the amassed Phases II through V on-site and in-depth samples. On-site and in-depth Phases II through V summary results are presented in Tables 9-4 and 9-5; individual on-site/in-depth Monroe County comparisons for each biasser are presented in Appendix C, Tables C-31 to C-46.

Table 9-4 presents Phases II through V in-depth findings. Results show that the Phase II through V in-depth sample is representative of Monroe County with respect to weather conditions, character of location, road surface condition, driver's license status and driver sex. Systematic selection bias has occurred for **urban and rural places**—an overrepresentation of rural and underrepresentation of urban accidents; **month of accident**—an underrepresentation of July through September accidents; **day of week**—an underrepresentation of accidents which occur on Friday; **severity of accident**—property damage accidents are underrepresented and injury producing accidents overrepresented; **light conditions**—daylight accidents are overrepresented and nighttime and dawn/dusk accidents underrepresented; **hour of accident**—accidents happening in the afternoon (12:00 p.m. to 3:59 p.m.) are overrepresented and evening/early morning accidents (8:00 p.m. to 7:59 a.m.) underrepresented; **accident type**—the sample is overrepresented with other collision, running off the road accidents and underrepresented with multi-vehicle collisions; **investigation source**—includes only state, sheriff and city police reported accidents; **driver age**—slightly overrepresented with 20-24 year old drivers; **vehicle type**—overrepresented with passenger vehicles and underrepresented with trucks and buses; **arrest**—overrepresented with drivers who were not arrested and underrepresented with drivers arrested for driving under the influence or for other violations.

Phases II through V on-site results are presented in Table 9-5. The II-IV on-site sample is representative of Monroe County (1972, 1973, 1974 combined statistics) with respect to urban

Table 9-4

Summary of the Study Area Representativeness of the Phases II, III, IV and V In-Depth Sample

Biasser	Difference of Percentages for Most Variant Category $\text{Max}\left\{\frac{I_i}{I} - \frac{n_i}{n}\right\} \times 100\%$	X^2 Significance	Largest Biasser Category	Appendix C Table No.
Weather Conditions	3.8	NS	Clear	C-38
Character of Location	4.3	NS	Intersection	C-40
Road Surface Condition	4.4	NS	Dry	C-37
Urban and Rural Places	4.8	*	Rural Area	C-31
Month of Accident	-5.3	*	July-Sept.	C-33
Day of Week	-5.9	***	Friday	C-32
Severity of Accident	-8.3	***	Property Damage	C-34
Light Conditions	9.6	***	Daylight	C-36
Hour of Accident	12.0	***	Noon to 3:59 p.m.	C-39
Accident Type	13.6	***	Other non-collision, running off the road	C-35
Investigation Source	-27.1	***	Was not investigated	C-41
Driver's License	.4	NS	Resident of State, No License	C-44
Driver Sex	2.2	NS	Female	C-42
Driver Age	3.2	**	20-24	C-43
Vehicle Type	3.9	**	Passenger Vehicle	C-45
Arrest	7.6	***	Driver not Arrested	C-46

* $p \leq .05$ — I_i —In-depth sample frequency count for category i

** $p \leq .01$ — I —Total in-depth sample observations

*** $p \leq .001$ — n_i —Study area frequency count for category i

NS Not Significant — n —Total study area observations

Data Sources: IRPS—Phases II through V in-depth sample; Monroe County—1972, 73 and 74 ISP data.

Table 9-5

Summary of the Study Area Representativeness of the Phases II, III, IV and V On-Site Sample

Biasser	Difference of Percentages for Most Variant Category $\text{Max}\left\{\frac{o_i}{o} - \frac{n_i}{n}\right\} \times 100\%$	X^2 Significance	Largest Biasser Category	Appendix C Table No.
Urban and Rural Places	.3	NS	Urban	C-31
Day of Week	-2.3	**	Thursday	C-32
Month of Accident	3.2	***	Jan-March	C-33
Severity of Accident	-4.1	***	Property Damage	C-34
Accident Type	4.8	***	Other non-collision, running off the road	C-35
Light Conditions	5.0	***	Daylight	C-36
Road Surface Condition	5.8	***	Dry	C-37
Weather Conditions	6.0	***	Clear	C-38
Hour of Accident	9.5	***	Noon to 3:59 p.m.	C-39
Character of Location	-12.4	***	All others (open road)	C-40
Investigation Source	-27.1	***	Was not investigated	C-41
Driver Sex	1.0	NS	Female	C-42
Driver Age	-1.7	NS	25-34	C-43
Driver's License	.7	***	Resident of State, not Licensed	C-44
Vehicle Type	1.9	***	Passenger Vehicle	C-45
Arrest	5.0	***	Driver not Arrested	C-46

* $p \leq .05$ — o_i—On-site sample frequency count for category i
** $p \leq .01$ — o—Total on-site sample observations
*** $p \leq .001$ — n_i—Study area frequency count for category i
NS Not Significant — n—Total study area observations.

Data Sources: IRPS—Phases II through V on-site sample; Monroe County—1972, 73 and 74 ISP data.

and rural places, driver sex and driver age. The II through V on-site sample is not representative of the study area (1972-73-74 combined statistics) with respect to **day of the week**—the on-site sample is underrepresented with Thursday accidents; **month of the accident**—overrepresented with January through June accidents and underrepresented with July through December accidents; **severity of accident**—underrepresented with property damage and overrepresented with personal injury accidents; **accident type**—overrepresented with non-collision, running off the road and multi-vehicle accidents and underrepresented with collisions with fixed objects, other objects or animals; **light conditions**—overrepresented with daylight and underrepresented with night and dawn/dusk accidents; **road surface conditions**—overrepresented with clear and underrepresented with rain, snow, fog or other conditions; **hour of accident**—overrepresented with noon to early evening (12:00 p.m. to 7:59 p.m.) and underrepresented with evening to late morning (8:00 p.m. to 11:59 a.m.) accidents; **character of location**—underrepresented with "open road" and overrepresented with intersection accidents; **investigation source**—only state, sheriff or city police reported accidents were investigated; **driver's license status**—slightly overrepresented with non-licensed residents; **vehicle type**—slightly overrepresented with passenger vehicles and underrepresented with trucks and buses. **Arrest status**—overrepresented with drivers not arrested and underrepresented with drivers arrested for driving under the influence or for other violations.

Summary

The Phase V in-depth sample is shown to be representative of all 1974 police reported Monroe County accidents for most biassers (light conditions, weather conditions, month of accident, urban and rural places, severity of accident, road surface condition, character of location, driver arrest status, vehicle type and driver sex). The most non-representative characteristics of the Phase V in-depth sample are hour of accident, accident type, investigation source and driver age. The Phase V in-depth sample is overrepresented with accidents which occur between the hours of 8:00 a.m. and 11:59 a.m., overrepresented with other non-collision/running off the road type accidents, underrepresented with accidents not reported by police agencies and overrepresented with 20-24 year old drivers.

The Phase V on-site sample is representative of 1974 Monroe County accidents with respect to urban and rural places, light conditions, month of accident, day of week, weather conditions, driver sex, driver age and driver arrest status. The most non-representative characteristics of the Phase V on-site sample are road surface condition, accident type, character of location and investigation source. The Phase V on-site sample is overrepresented with dry road accidents; overrepresented with other non-collision/running off the road accidents; overrepresented with intersection accidents and underrepresented with non-police reported accidents.

The Phase II through V in-depth sample is representative of 1972, 1973, 1974 Monroe County accidents with respect to weather conditions, character of location, road surface condition, driver's license status and driver sex. The most non-representative characteristics of the Phase II through V in-depth sample are **light conditions** — an overrepresentation of daylight accidents; **hour of accident** — an overrepresentation of accidents occurring from 12: 00 p.m. to 3:59 p.m.; **accident type** — an overrepresentation of other non-collision/running off the road type accidents; **investigation source** — an underrepresentation of accidents not investigated by police agencies and **arrest status** — an overrepresentation of drivers not arrested.

The Phase II through V on-site sample is representative of 1972, 1973 and 1974 Monroe County accidents with respect to urban and rural places, driver sex and driver age. The most non-representative characteristics are **light conditions**—overrepresented with daylight accidents; **road surface condition**—overrepresented with accidents which occur on dry road surfaces; **weather conditions**—overrepresented with clear weather conditions; **hour of accident**—overrepresented with accidents which occur between 12:00 p.m. and 3:59 p.m.; **character of location**—underrepresented with open road accidents; **investigation source**—underrepresented with non-police reported accidents; **arrest status**—overrepresented with drivers not arrested.

9.3 Effects of Nonuniform Sampling on Estimates of Causal Involvement

The purpose of this section is to identify accident configuration characteristics which are related to accident causation and to assess the effects of nonuniform sampling (with respect to these selected characteristics) on aggregate probable level **on-site** measures of pre-crash human, vehicle and environmental involvement.

Methodology

Determination of the effects of nonuniform sampling on estimates of causal involvement is accomplished by identifying accident, driver and vehicle characteristics (biassers) which are related to aggregate measures of human, vehicle and environmental involvement; estimating the national distribution of each biasser; numerically adjusting the IRPS' sample so as to reflect the national estimate and measuring the resultant effect on estimates of human, vehicle and environmental involvement.

Results of two-sample chi-square tests are used to determine which driver/vehicle/accident characteristics are related to **aggregate** measures of human, vehicle and environmental causation. Characteristics selected for analysis are month of accident, day of week, hour of accident, urban and rural places, severity of accident, accident type, character of location, road surface condition, weather conditions, light conditions, driver sex, driver age, driver license status, vehicle type and arrest status. Accidents/drivers/vehicles are divided into two groups—an involved group with respect to the selected causal factor and an uninvolved group. Distribution differences (for each characteristic above) between involved and uninvolved groups are measured with the two-sample chi-square test. When distribution differences are large enough to occur only 5% of the time by chance, the characteristic is considered a potential source of sampling bias and marked for further analysis.

Chi-square test results for each comparison are presented in Table 9-6. As an example and explanation of this analytical technique, the effects of "month of accident" on human, vehicle and environmental involvement are discussed below.

Results of tests to determine the relationship between month of accident and the involvement of human, vehicle and environmental factors (presented in row 1 of Table 9-6) indicate "month of accident" does not affect the rate of human involvement in accidents ($p > .05$) but does influence the rate of environmental ($p=.0201$) and vehicle ($p=.0352$) involvement. Because month of accident and human involvement are not related, human causation estimates from samples which are stratified **improperly** on month of accident will **not** be adversely affected. On the other hand, environmental and vehicle involvement estimates from samples stratified improperly on month will be adversely affected, e.g., in this study area, environmental involvement is more probable in accidents which occur in October through March—oversampling October through March accidents will cause estimates of environmental causation to be overstated; vehicle involvement is less probable in accidents which occur in July, August or September—oversampling July through September accidents will cause estimates of vehicle involvement to be understated.

Once biassers are identified, national distribution estimates for each biasser are collected. Two major sources of national data are available—Accident Facts, 1974 edition and the National Accident Summary File, 1972 statistics. National estimates are not available from these sources for some biassers considered. In these cases Monroe County distributions (1972-73-74 statistics) were used as the national estimate.

National estimates are available for hour of accident, urban and rural places, severity of accident, accident type, character of location, road surface condition, light conditions, driver sex, driver age and vehicle type. Comparisons of on-site and in-depth samples with the nation for these biassers are presented in Tables C-47 through C-56 of Appendix C. The on-site sample (when compared with national estimates) is underrepresented with accidents occurring during the hours 8:00 p.m. to 11:59 a.m. and overrepresented with 12:00 p.m. to 7:59 p.m. accidents; overrepresented with rural and underrepresented with urban accidents; overrepresented with property damage and underrepresented with personal injury accidents; overrepresented with multiple vehicle and underrepresented with single vehicle accidents; overrepresented with intersection and underrepresented with non-intersection accidents; underrepresented with snowy or icy road surface conditions; overrepresented with daylight and underrepresented with accidents which occur in darkness; overrepresented with female and underrepresented with male drivers; overrepresented with 20-24 year old and underrepresented with 25 and older drivers and overrepresented with passenger vehicles and underrepresented with trucks.

National estimates are not available for the following characteristics: month of accident, day of week, weather conditions, driver's license status and arrest status. In these cases, the Monroe County distribution (1972, 1973 and 1974 statistics) were used to estimate the nation. On-site/in-depth comparisons for these biassers are presented in Tables C-57 through C-61.

Table 9-6

Effects of Non-Representative Sampling with Respect to Selected Accident/Driver/Vehicle Characteristics on Aggregate Measures of Human, Environmental and Vehicular Factors (Phase II thru V probable level, on-site data)

Accident/Driver/Vehicle Characteristics	CAUSAL FACTOR					
	Human		Environmental		Vehicular	
Month of Accident	NS	--	p=.0201	(6)-0.13%	p=.0352	(4)-1.06%
	--	--	34.9%	34.9%	9.1%	9.0%
Day of Week	NS	--	NS	--	NS	--
	--	--	--	--	--	--
Hour of Accident	p=.0054	(5)-0.97%	NS	--	NS	--
	90.3%	89.4%	--	--	--	--
Urban and Rural Places	p=.0001	(8)+0.41%	p≤.0000	(3)-2.83%	NS	--
	90.3%	90.7%	34.9%	33.9%	--	--
Severity of Accident	NS	--	NS	--	NS	--
	--	--	--	--	--	--
Accident Type	p≤.0000	(3)-1.18%	p≤.0000	(1)+4.44%	p=.0003	(1)+8.02%
	90.3%	89.2%	34.9%	36.4%	9.1%	9.8%
Character of Location	p=.0046	(9)-0.36%	p=.0001	(5)+2.02%	NS	--
	90.3%	90.0%	34.9%	35.6%	--	--
Road Surface Condition	p=.0007	(4)-1.11%	p≤.0000	(4)+2.64%	p=.0037	(3)-1.10%
	90.3%	89.3%	34.9%	35.8%	9.1%	9.0%
Weather Conditions	NS	--	p≤.0000	(2)+3.92%	NS	--
	--	--	34.9%	36.3%	NS	--
Light Conditions	p=.0025	(6)-0.64%	NS	--	NS	--
	90.3%	89.7%	--	--	--	--

Table 9-6 continued

Driver	NS	--	NS	--	NS	--
Sex	--	--	--	--	--	--
Driver	p≤.0000	(2)-1.20%	NS	--	p=.0001	(2)-4.17%
Age	90.3%	89.2%	--	--	9.1%	8.7%
Driver License	p≤.0000	(10)+.13%	NS	--	NS	--
Status	90.1%	90.4%	--	--	--	--
Vehicle	p=.0028	(7)-.60%	NS	--	NS	--
Type	90.3%	89.8%	--	--	--	--
Arrest	p≤.0000	(1)+3.22%	NS	--	NS	--
	90.3%	93.2%	--	--	--	--

Key:

Chi-square Significance	( ) Adjustment factor as a percentage
%Involvement Before Adjustment	%Involvement After Adjustment

- Chi-square Significance: Indicates the statistical significance of the relationship between accident/driver/vehicle characteristic and causal factor
- Adjustment factor as a percentage: AF =[(IA–IB)/IB] · 100. (See below for explanation of symbols).
- ( ): Rank of accident/driver/vehicle characteristic with respect to the causal factor listed on the column. Nonrepresentative sampling with respect to characteristics with high rank (e.g., 1) have affected estimates of causal involvement more than those with low (e.g., 10) rank.
- %Involvement Before Adjustment: Percent of accidents caused by human, environmental or vehicle factors (I–see below for explanation of symbol).
- %Involvement After Adjustment: IAA = I + (I·AF/100.) – See below for explanation of symbols.

NS—Not Significant, indicates relationship between accident/driver/vehicle characteristic was not strong enough for adjustment to be made (p>.05).
AF—Adjustment Factor
IA—Number of accidents with causal involvement after adjustment for nonrepresentative sampling.
IB—Number of accidents with causal involvement before adjustment for nonrepresentative sampling.
IAA—Percent of accidents caused by human, environmental or vehicular factors after adjustment for nonrepresentative sampling.
I—Percent of accidents caused by human, environmental or vehicular factors before adjustment for nonrepresentative sampling.

When compared with Monroe County distributions, the on-site sample is overrepresented with January through June accidents and underrepresented with July through December accidents; underrepresented with Thursday accidents; overrepresented with clear and underrepresented with rain, snow, fog or other weather conditions; slightly overrepresented with non-licensed residents; overrepresented with drivers not arrested and underrepresented with drivers arrested for driving under the influence or for other violations.

Having collected national estimates for each biasser, elements of the on-site sample are weighted so the resultant weighted distributions exactly reflect the national estimate. Adjusted aggregate human, vehicle and environmental involvement rates are then calculated from the **weighted** distributions. These adjusted rates are estimates of what would be expected if IRPS' samples were stratified to reflect the nation. Each biasser is investigated independent of influences of other biassers. A detailed example of the adjustment procedure is presented in Vol. I of "Tri-Level Study of the Causes of Traffic Accidents: Interim Report II," p. 124-127.

Results of causal adjustments for nonuniform sampling are presented in Table 9-6. The percent increase or decrease in causal involvement to adjust for nonuniform sampling fraction, the rank of each biasser as measured by the magnitude of effect on aggregate causal involvement and involvement rates before and after adjustments for nonrepresentative sampling are displayed for each causal factor/biasser combination.

The on-site human involvement estimate is affected to the greatest extent by nonuniform sampling with respect to arrest status. This is because of two factors working in combination. First, human involvement for arrested, accident-involved drivers is significantly greater than for drivers not arrested ($p \leq .0000$); and second, drivers **arrested** for some violation are underrepresented in the on-site sample. Since human involvement is more probable for drivers who are arrested, undersampling arrested drivers causes estimates of human involvement to be understated. The second most influential biasser of on-site estimates of human involvement is driver age. Human involvement is more probable for accident-involved drivers 24 and under and 65 and over ($p \leq .0000$). Oversampling accident-involved drivers 20-24 has caused on-site estimates of human involvement in accidents to be overstated.

Accident type, road surface condition and hour of accident are the third, fourth and fifth most influential biassers of on-site estimates of human involvement. Human involvement is more probable in multi-vehicle than in single vehicle accidents ($p \leq .0000$); more probable on dry or wet road surfaces than on icy or snowy surfaces ($p=.0007$) and more probable during the hours 8:00 a.m. to 7:59 p.m. than 8:00 p.m. to 7:59 a.m. ($p=.0054$). Oversampling multiple vehicle accidents, dry and wet road surface conditions and 8:00 a.m. to 7:59 p.m. accidents has caused on-site estimates of human involvement to be overstated.

Other biassers which influence human involvement are light conditions, vehicle type, urban and rural places, character of location and driver's license status. Human involvement is most probable during dawn or dusk, less probable during daylight and least probable at night ($p=.0025$); more probable when the involved vehicle is a truck or passenger car and less probable when the involved vehicle is a motorcycle ($p=.0028$); more probable in urban than rural areas ($p=.0001$); more probable in intersection than nonintersection accidents ($p=.0046$) and more probable when the driver is a resident of the state with no license or a nonresident than if he is a state resident ($p < .0000$). Non-representative sampling with respect to these factors has affected on-site estimates of human involvement only slightly.

Biassers which influence the involvement rate of environmental factors are (in order of effect on the on-site sample) *accident type, weather conditions, urban and rural places*, road surface condition, character of location and month of accident. Environmental involvement is more probable in single than in multiple vehicle accidents ($p \leq .0000$); more probable in rainy, snowy or foggy than clear weather conditions ($p \leq .0000$); more probable in rural than in urban areas ($p \leq .0000$); more probable on wet, snowy or icy than on dry roads ($p \leq .0000$); more probable in nonintersection than intersection accidents ($p \leq .0001$) and more probable in October through March than in April through September ($p=.0201$). Undersampling single vehicle accidents; accidents which occur during rainy, snowy or foggy weather conditions or on wet, snowy or icy road surfaces; and accidents which occur on the open road has caused on-site estimates of environmental involvement to be **understated.** Oversampling rural areas has led to an overstatement of environmental involvement. Non-representative sampling with respect to month has affected on-site estimates of environmental involvement only slightly.

Estimates of vehicle involvement are affected by accident type, driver age, road surface condition and month of accident. Vehicle involvement is more probable in single than in multiple vehicle accidents ($p=.0003$); more probable when the vehicle driver is under 20 and less probable if the driver is 35-54 years old ($p=.0001$); more probable if the road surface is wet ($p=.0037$) and more probable if the accident occurs in October through June than if it occurs in July, August or September ($p=.0352$). Oversampling multi-vehicle accidents has caused on-site estimates of vehicle involvement to be understated. Undersampling of older age groups, wet road surface conditions and July, August and September accidents has caused on-site estimates of vehicle involvement to be overstated.

In summary, non-representative sampling with respect to various accident/driver/vehicle characteristics can bias estimates of aggregate measures of the role of human, vehicular and environmental factors in accidents.

Estimates of human involvement in accidents will be **understated** if:

- Arrested drivers are undersampled.
- Nonlicensed drivers or out-of-state residents are undersampled.
- 25 to 64 year old drivers are undersampled.
- Multiple vehicle accidents are undersampled.
- Urban accidents are undersampled.
- Dry or wet road surfaces are undersampled.
- Dawn or dusk accidents are undersampled.
- Motorcycle accidents are oversampled.
- Accidents during the hours 8:00 a.m. to 7:59 p.m. are undersampled.

Estimates of environmental involvement in accidents will be **understated** if:

- Single vehicle accidents are undersampled.
- Accidents during rainy, snowy or foggy weather conditions are undersampled.
- Rural accidents are undersampled.
- Accidents on wet, snowy or icy roads are undersampled.
- Nonintersection accidents are undersampled.

Estimates of vehicle involvement in accidents will be **understated** if:

- Accident-involved drivers under 20 are undersampled.
- Single vehicle accidents are undersampled.
- Accidents on wet road surfaces are undersampled.

10.0 Summary, Conclusions and Recommendations

In this section, results are summarized and conclusions and recommendations presented for both Volumes I and II of this Final Report. Causal result tabulations and analyses are based on combined data from Phases II through V, and in order to simplify the presentation, results from the in-depth team (Level C) are emphasized. These tabulations are based on 420 accidents investigated by the in-depth team, and 2,258 accidents investigated by the on-site teams, during Phases II through V.

10.1 Volume I: Causal Factor Tabulations and Assessments

10.1.1 Section 3.0: Causal Result Tabulations

1. Overall, and in each of the data collection phases, of the human, vehicular, and environmental factors which were assessed, those categorized as "human factors" were the most frequently cited as accident causes, followed by environmental and vehicular factors, respectively. Human factors were identified by the in-depth team as causes of between 70.7 and 92.6% of the combined Phase II, III, IV and V accidents (definite and probable result figures, respectively). Environmental factors were cited as causes of between 12.4 and 33.8% of these accidents, while vehicular factors were identified as causes in 4.5% to 12.6% of the accidents investigated. The on-site/technician teams (Level B) reported similar results: human factors, 64.3—90.3%; environmental factors, 18.9—34.9%; and vehicular factors, 4.1—9.1%.

2. Of the five major categories of human direct causes which were defined, recognition and decision errors predominated. These categories were ranked as follows: (1) recognition errors (in-depth team definite and probable results of 41.4 and 56.0%, respectively); (2) decision errors (28.6—52.1%); (3) performance errors (6.9—11.2%); (4) critical non-performances (1.7—2.1%); and, (5) non-accident/intentional involvements (none identified).

3. Below the major categories of human direct causes mentioned in the preceding paragraph, a number of more specific human direct cause categories were defined. Among these, those most frequently cited as accident causes were: (1) improper lookout (17.6—23.1%); (2) excessive speed (7.9—16.9%); (3) inattention (9.8—15.0%); (4) improper evasive action (4.8—13.3%); and (5) internal distraction (5.7—9.0%).

4. The leading environmental factors were: (1) view obstructions (3.8—12.1%); (2) slick roads (3.8—9.8%); (3) transient hazards (1.9—5.2%); (4) design problems (1.9—4.8%); and (5) control hindrances (1.2—3.8%).

5. Vehicular factors were categorized first in terms of the major vehicular systems. According to this breakdown, the most frequently implicated categories were: (1) braking systems

(2.9—5.2%); (2) tires and wheels (0.5—4.0%); (3) communications systems (0.2—1.7%); (4) steering systems (0.2—1.0%); and (5) body and doors (0.5—0.7%).

6. Assessments were also made for more specific kinds of problems within each major system. At this level, the most frequently-implicated vehicular causal factors were: (1) gross brake failure (1.9—3.1%); (2) inadequate tread depth (0.2—2.6%); (3) side-to-side brake imbalance (1.0—1.9%); (4) underinflation (0.0—1.4%); and (5) vehicle-related vision obstructions (0.2—1.0%).

7. Based on both on-site and in-depth probable cause data from Phases II through V, it was found that at about the seventh or eighth year of vehicle age, an overinvolvement in accidents resulting from mechanical problems begins. The probability of an accident-involved vehicle 8 years of age or older being cited for a causative vehicular problem was more then 2 times greater than for accident-involved vehicles in general.

8. The most frequently-implicated human condition or state was alcohol-impairment, which the in-depth team assessed as a cause in 0.5—3.1% (definite — probable involvement) of the combined Phase II-V accidents. Comparable results from the on-site team, examining a greater number of accidents and with less potential for bias through non-cooperation of impaired drivers, were 2.9—6.1%. Note that accidents investigated represented all severities of police-reported accidents, and are consequently comprised in large measure of either property damage or minor personal injury accidents (approximately 70% were property damage only). Results here should therefore not be confused with those cited for only serious or fatal accidents; alcohol is often cited as being involved in 40 to 50% of these serious accidents. Results for alcohol-impairment varied considerably from phase to phase and as a function of whether accidents were selected from all hours of the day or only from limited periods, and the reader is therefore cautioned to consult the text for further clarification.

Recommendations

General

1. The causal factor tabulations serve a "problem identification" function, for use in planning future countermeasure activity. Inevitably, such "problems" must be viewed in the context of the process through which they were identified, and the types of factors considered must be taken into account. It certainly does not follow that because a factor has been classified as, for example, a human factor, the most cost-effective solution will be one aimed at changing driver behavior. Possibly, highway or vehicle design changes may provide a better remedial measure. For example, although "inattention to traffic stopped or slowing ahead" has been tabulated as a frequently-involved human causal factor, it may well be that the most cost-effective solution is either redesign of highways or signals to minimize "stop and go" traffic situations (environmental measure), or the installation of radar-warning braking systems or improved brake lights (vehicle measures).

2. In the same sense, indications of the relative involvement of, for example, human factors as compared to vehicular factors, are informative and accurate only when the kinds of assessments which were included and the process which produced them are understood. Note, for example, that the "vehicular causal factors" assessed generally assumed the current state-of-the-art; current original-equipment performance provided a baseline for assessment. Consequently, vehicle results have few direct implications for such issues as the desirability of vehicle handling standards. In much the same way, environmental design factors were considered relative to existing standards; thus, the absence of a divided highway and median strip would not be considered a potential causal factor, even though it might have prevented an accident from occurring. Consequently, although human factors were identified much more frequently than either vehicular or environmental factors, it is entirely possible that improvements in either the vehicular or environmental areas could prove more cost effective than correction or elimination of many of the human errors identified. It is likely that a mix of countermeasure efforts encompassing all three targets (driver, vehicle, and environment) will often be needed.

3. In many applications, these limitations (as described above) pose little problem. For example, for a driver examiner conducting a driving test, the listing of causal factors provides a suitable guide as to the kinds of behaviors the examiner should emphasize, as well as the vehicular and environmental hazards he or she should stress. The examiner is not so much interested in the range of safety countermeasures available, as in knowing the relative importance of different kinds of driving behavior, and the causal factor tabulations should serve this purpose well. Similarly, vehicle factor tabulations are of use to inspection programs, mechanics, vehicle owners, and others concerned with vehicle maintenance; results serve to indicate the extent to which different defects, degradations, maladjustments, and failures are causally-implicated in accidents.

Human Factors

1. Major emphasis should be placed on developing countermeasures to reduce the incidence and consequences of improper lookout, excessive speed, inattention, and improper evasive action (the four leading human direct causes). It is likely that alcohol-impairment also warrants special concern due to the greater severity of accidents where it is involved (see Volume I, Section 5.0).

2. Knowledge of the importance of these driving errors and the context in which they are most likely to result in accidents must be communicated to drivers. Information from this and other studies of accident causes should be incorporated in state driver license manuals, written and on-road driving license tests, and driver education curricula. The Department of Transportation/NHTSA public information papers, announcements, and televised messages should also incorporate this information.

3. "Improper lookout" was the leading accident cause identified. It is important to recognize that nearly one-fourth of all the accidents which IRPS investigated resulted from drivers who changed lanes, passed, or pulled out from an intersecting alley, street, or driveway without looking carefully enough for oncoming traffic. More focused examinations indicated that about half of the individuals cited for "improper lookout" had totally failed to make any surveillance effort, while the remainder had looked but failed to see oncoming traffic which should have been visible. Further research is needed to identify the behavioral components and level of attention which comprise a "proper lookout," so that adequate training, licensing, and enforcement measures can be devised. More focused analyses of the interactions with environmental design features are also necessary, so that roadways, signs, signals, and other environmental features can be set to minimize the incidence of "improper lookout." It is significant that for the drivers who "looked but failed to see," approximately 40% faced a view obstruction which added to the difficulty of their surveillance task, even though it was assessed that this difficulty could and should have been easily overcome. Also of significance is the over-involvement of drivers 65 years of age and over in committing "improper lookout"; of drivers over 65 who caused accidents, approximately half had made errors of this kind. Future research should try to identify the relevant mechanisms (e.g., mechanical difficulties in turning the head, reduction in visual field or other visual skills, or changes in field dependence) in order to suggest appropriate countermeasures, such as specialized training programs.

4. Particularly relevant in considering countermeasures for the "excessive speed" category is the overrepresentation of males and females less than 20 years of age among those cited for this factor (18.1% of males under 20 years of age committed this error, compared to only 10.2% of accident males generally; 8.6% of females under 20 committed this error compared to 5.2% for accident females, generally). The interaction with roadway familiarity also merits attention. Most of the excessive speed errors occurred with reference to "road design," primarily in the sense of exceeding the critical speed for a curve and thereby losing control. The motivations underlying risk-taking behavior among young drivers (particularly males), as well as their skills in vehicle handling and judgment of roadway requirements, may require closer examination, and possibly a reevaluation of present driver training programs.

5. "Inattention" most frequently involved a delay in detecting that traffic ahead was either stopped or decelerating, and less frequently a failure to observe critical road signs and signals. Aside from informing drivers (through public information and driver education programs, etc.) of the importance of attentiveness to the driving task, possible areas of improvement include changes in the size, prominence, or placement of road signs and signals; other environmental changes to reduce the incidence of sudden stops; installation of in-vehicle communication systems, such as radar warning or actuation systems to avoid

contact in the rear-end configuration mode; and installation of improved brake lights (e.g., with possible changes in intensity, color, or pulsation characteristics).

6. Many drivers were cited for "improper evasive action." The two major subcategories of this error involved either failure to attempt an appropriate (and often easily accomplishable) evasive steer, or negation of what would have been a successful evasive steer through over-braking, with a resultant lock-up of the front wheels (rendering the steering input ineffective). Again, a first action should be to inform drivers of the nature and attendant risks of these particular errors. However, further advances would require careful research to determine the most effective means of upgrading the evasive skills of drivers. Perhaps a classroom experience can be beneficial, but it is likely that simulator and actual in-vehicle practice would be required. Four wheel anti-lock braking systems are an effective vehicle-oriented countermeasure for front wheel lock-up through over-braking. Possibly, the relationship between braking pedal displacement and/or force and braking power on existing braking systems might also be improved.

Environmental Factors

1. Undoubtedly, environmental improvements, including implementation of divided highways and elimination of many at-grade intersections, have contributed heavily to the continuing reduction in fatality rates over the past 50 years or so. Yet the IRPS hierarchy was aimed at assessing the relative importance of various kinds of problems and deficiencies within the current highway system, rather than the benefits of further improvements and upgrading beyond a currently acceptable status. In this sense, study results may be more directly informative to highway maintenance personnel than, for example, to a state or federal highway safety planner concerned with determining whether money could be best spent in dividing a highway or putting in an overpass, rather than on other countermeasures.

2. Within this context, the major problems identified were view obstructions (such as trees, shrubbery, or parked cars restricting sight-distances at intersections), and slick roads (a factor which was tallied whenever it was judged that a particular accident would not have happened on dry pavement). Much less frequently involved were maintenance problems (such as missing signs or inoperable signals); control hindrances (such as pavement edge drop-offs); and inadequate signs and signals (e.g., curve warning sign needed but not provided).

3. Accidents in which *view obstructions* were involved most frequently occurred at regular road/road intersections, generally having stop signs on only two of the legs, and with the erring driver almost always on a controlled leg. The erring driver was often intent on going straight and sometimes on turning left, but was almost never attempting to turn to the right. While some of these view obstructions would be difficult to remove — such as buildings,

legally-parked cars, and large embankments — the biggest share (more than half) consisted of trees and bushes, which might more easily be removed — particularly if removal efforts were focused only on intersections which accident records indicate to have high accident rates and/or frequencies. Countermeasures here include local surveys to identify view obstruction problems, and direct appeals to property owners to have such problems corrected. State and civic leaders can also work with business and civic groups, and through the news media, to encourage business and property owners to assess their own property to ensure that they are not contributing to this important safety problem. Another large share of these view obstructions resulted from parked vehicles, nearly half of which were illegally parked. Hence, installation and enforcement of parking prohibitions serves an important safety function; it is important that law enforcement and the public alike perceive this importance.

4. Under the "slick roads" category, rain-slickened roads predominated (possible causal factors in up to 10% of these accidents), while snow or ice covered roads were implicated as causally relevant in up to 4% of these accidents. Interactions with vehicular factors — especially tire tread depth — are evident; vehicle and tire problems were more frequently implicated when the road surface was damp or when precipitation was heavy, with control losses often occurring on curves. In addition to informing and better educating drivers in the safe negotiation of rain, snow and ice-slickened roadways, potential countermeasures lie in the areas of improved road design to eliminate such curves where possible; pavement grooving or other procedures to improve wet road traction, particularly at locations indicated to have a disproportionate number of accidents under wet road conditions; and improved tire design and inspection programs to improve traction on wet, snow, or ice-covered roads. Some research suggests that a major problem with slick roads is that they are not perceived as such by drivers; hence, variable signing systems that provide information on road slipperiness might also be of benefit.

Vehicular Factors

1. Vehicular results were assessed with reference to the current "original equipment" state-of-the-art, and therefore do not directly indicate the safety benefits of possible future improvements, such as four wheel anti-lock braking systems or significantly improved handling characteristics. Results are, however, directly useful in targeting systems for vehicle inspection programs, and for focusing the attention of vehicle owners and others who play a role in vehicle maintenance.

2. Results indicate that brake failures, inadequate tread depth, and brake imbalances are the three leading vehicular accident causes. Consequently, these should be priority items in efforts to upgrade vehicle inspection and maintenance programs, and should be emphasized in consumer information/education programs aimed at making vehicle owners more active and knowledgeable participants in maintaining safe vehicle condition. Owners need to

know what items are critical to inspect, how they can be checked, and which items require the attention of a qualified mechanic. Following the three priority items, the vehicular factors meriting greatest attention are underinflation, vehicle-related vision obstructions, excessive steering freeplay, inoperable lights and signals, and inoperable door latching mechanisms.

3. Among accident-causing brake system problems, gross failures and side-to-side imbalances predominated. More than half of the components responsible for the causal brake problems observed were contained within the wheels. The failures encountered resulted from such factors as wear and adjustment permitting over-travel of wheel cylinder pistons, and dislodging of the star wheel assembly through improper assembly of self-adjustor mechanisms. Most of these failures occurred in older vehicles having only single chamber master cylinders. Side-to-side imbalances most frequently resulted from metal-to-metal contact, permitted by excessively worn linings, and less frequently from friction material contamination. In order to achieve their accident-reduction potential, inspection programs must be able to detect and objectively evaluate these problems. It is likely that a good visual inspection, such as could be accomplished through wheel pulling, would detect the vast majority of these problems. Alternatively, testing on a dynamic brake tester, or on-road testing from relatively high speeds, are probably superior means of detecting side-to-side imbalances, although they most likely would not detect and permit correction of those in-wheel problems which led to brake failure. Factors external to the wheel which accounted for brake failures included brake hose failures and problems in the master cylinder (e.g., sand in the compensator port, out-of-round primary piston seal).

4. Regarding inadequate tread depth, it was found that 19% of the vehicles IRPS inspected on Level C had at least one tire with less than 2/32" of tread, while 10% had at least two tires below this level, 3.5% had three, and 0.7% (five vehicles) had all four tires below this standard. This was true despite Indiana's annual vehicle inspection program, which incorporates a 2/32" tread depth standard. While problems with the inspection program may be partially responsible (it was estimated that 29% of a set of degraded components[1] which IRPS found on accident-involved vehicles were present and should not have passed at the time of the vehicle's last state inspection), normal wear of tires between yearly inspection intervals is a major factor (i.e., a tire which passes today could be below the standard a month or two from now). An alternative would be to increase the inspection standard to some higher figure (perhaps 4/32"), although consumer opposition and increased enforcement difficulties might be anticipated. Alternatively, owners can be at least given a warning if they are below some higher standard (such as 4/32"), possibly with an estimate as to when the 2/32" level will be reached.

[1] The components in this set consisted of wipers, exhaust, freeplay/steering system, and tread depth. These items constitute a subset of components evaluated by the in-depth team.

5. Underinflation was primarily implicated as a possible or probable factor contributing to poor vehicle handling in control loss situations. Based on the high incidence of improperly-inflated tires on vehicles IRPS inspected, it appears unlikely that the typical owner engages in routine checks on inflation, or is adequately concerned about the potential influence of improper inflation on vehicle control. In addition to better informing and educating drivers on this subject, vehicle inspection stations can be required to advise owners regarding tire pressure problems, major oil companies and service station operators can be encouraged to actively participate in checking pressures and advising motorists; and visible pressure warning indicators can be installed to inform drivers when inflation problems exist. In addition to safety, energy conservation and tire life benefits can also be stressed. While underinflation can also lead to tire failure, study results do not support sudden failures as a frequent cause of accidents.

6. Particular attention should be directed to providing adequate consumer information and education concerning vehicle maintenance. Contemporary concerns regarding consumer fraud may have created an atmosphere of skepticism which may sometimes result in desirable repairs and other maintenance practices not occurring. For example, it is possible that consumers may resist installation of new wheel cylinders and seals when having brakes relined, and mechanics may be reluctant to recommend it. In addition, mechanics may feel compelled to eliminate these items in a relining estimate, in order to assure that their bid is competitive. An informed consumer should be able to better distinguish unnecessary from valid preventative maintenance actions.

7. In the continued upgrading of vehicle inspection programs, it is necessary not only to key on those systems and components which are responsible for accidents, but to ensure that inspection procedures, and inspector skills and equipment are up to the task through adequate training, licensing, and program monitoring. For example, brake hose or line failure was responsible for several of the brake failures which caused accidents, yet a visual brake hose and line examination is not required in many programs. In some, at least, a high pedal force application is required, which might detect some incipient failures. However, it is believed that a visual examination could detect additional problem cases; those brake hose failures in the IRPS file which resulted from rubbing against an improperly-installed muffler, and from rubbing against a wheel rim during turns, are cited as examples. However, such a requirement implies a need for training as to likely failure points or sources of interference, and to assess degrees of deterioration in lines and hoses. It continues to be true that in many states inspection personnel receive no training whatever, and licensing requirements are often minimal. The inspection activity must also be adequately monitored to ensure that there is accountability on the part of inspectors and inspection stations for their performance. Too often, consumer complaints comprise the major source of information on station performance.

8. While most of the vehicular problems which caused accidents could have been prevented by

"proper maintenance," the possibility of reducing the need for such maintenance through design innovations and improvements must not be overlooked. While failure to perform needed maintenance poses one set of problems (e.g., as when worn linings permit metal-to-metal contact, leading to a brake imbalance), maintenance carries with it the possibility of improper repair or assembly (e.g., as where an improperly-assembled self-adjuster leads to brake loss through overextension of a wheel-cylinder piston, or where a new and slightly different muffler puts the tailpipe in contact with a brake hose). Desirable improvements might include seals which prevent friction materials contamination over extended periods; longer-lasting brake linings and pads; driver warning/information systems to warn drivers and possibly encourage correction of degraded conditions; and component parts (such as brake adjuster mechanisms) which are designed to decrease the likelihood of improper assembly (especially by the growing number of amateur and owner-mechanics).

9. Vehicle causation problems should continue to be monitored in the future, since the continuous introduction of mechanical innovations will alter the relative involvement of the various problems and systems, requiring a periodic readjustment of inspection items and programs. The dual-chamber master cylinder, in particular, should cause a gradual reduction in the causal involvement of brake failures, which were the predominant vehicle problem in the IRPS data. The advent of disc brakes may also gradually alter these results, particularly as disc brake-equipped vehicles begin to make up a significant proportion of the high mileage/order vehicle population—which was responsible for a disproportionately large share of vehicle problems in the IRPS data.

10.1.2 Section 4.0: Trend Analysis Across Phases

1. For the overall categories of human, environmental and vehicular factors, phase-to-phase changes were large enough to be reflected in several statistically-significant trends. Involvement of human and environmental factors tended to decrease from phase-to-phase, while vehicular factor results varied erratically. Reasons for these changes were not clearly identified, and could reflect variances arising from the clinical assessment procedure.
2. For the ten most frequently identified causal factors, significant trends were identified either in the on-site or in-depth data for five factors. These were: (1) inattention (downward trend, on-site); (2) improper evasive action (downward trend, on-site and in-depth); (3) false assumption (downward trend on-site, mixed trend in-depth); (4) improper driving technique (mixed trend on-site and in-depth); and (5) inadequately defensive driving technique (mixed trend on-site).
3. However, for the two highest ranking human factors (improper lookout and excessive speed), the two most frequent environmental factors (view obstructions and slick roads), and the most frequent vehicular accident cause (brake system problems), significant trends did not occur in either on-site or in-depth data. Thus, for the most frequently cited human,

environmental, and vehicular factors, results changed very little across the four phases (II-V), either on-site or in-depth.

10.1.3 Section 5.0: Analysis of Accident Severity as a Function of Accident Causation

1. In this analysis, accidents involving individual causal factors were compared with all accidents investigated, in terms of the proportion involving either property damage (PD only), or personal injury/fatality (PI/F). Only two causal factors were found to be significantly more serious (in overrepresenting the PI/F class) in both the on-site and in-depth data; these were alcohol-impairment and excessive speed.
2. In addition, in the on-site data only, accidents involving control hindrances (an environmental factor including such problems as pavement edge drop-offs) and tire/wheel problems, were significantly more serious. These factors therefore merit increased concern beyond that indicated merely by their frequency of involvement.
3. Factors associated with less than expected severity (in the sense of significantly underrepresenting the PI/F class of accidents) were false assumption, external distraction, and improper lookout.[2] Note that the last of these — improper lookout — was the study's most frequently implicated causal factor, according to both on-site and in-depth data. Its importance by virtue of frequency of involvement is offset somewhat by its lesser severity. In contrast, the increased severity associated with the second-ranking factor — excessive speed — greatly increases its importance.

10.1.4 Section 6.0: Driver Conditions and States in Combination with Other Factors

1. This analysis investigated interactions of causally-implicated "human conditions and states" (which may be considered human indirect causes as opposed to direct behavioral causes), with both human direct causes and environmental causal factors. One or more condition or state was cited at the "possible cause" level or above for 102 of the 720 drivers tested and interviewed by the in-depth team; these were compared with the direct causes attributed to the same drivers at the "probable cause" level or above, and to the environmental factors cited as causally-relevant to their accidents, at these same levels.
2. Numerous statistically significant interactions were identified, including the following: when alcohol impairment was causally implicated, the likelihood of excessive speed and "other direct causes" being cited was significantly increased. The causal implication of fatigue was associated with a greater incidence of critical non-performance (falling asleep), inattention, and "other direct causes:" reduced vision was associated with increases for improper lookout and view obstru[illegible]tional upset with inattention; "in-hurry" with excessive speed; driver inexperience with inadequate directional control and highway

[2] On-site data. In the in-depth data, none of the factors significantly underrepresented the PI/F class.

design factors; vehicle unfamiliarity with inadequate directional control, highway design, and slick roads; and roadway unfamiliarity with excessive speed, control hindrances, and inadequate signs and signals.

Recommendations

1. Should future studies yield the same pattern of relationships observed here, there would be numerous possible applications to a variety of countermeasure programs. For example, driver education/information programs might:
   - Stress that if driving while under the influence of alcohol, key concerns are to avoid falling asleep and speeding (while the point on speeding may be well-known, recognition of falling asleep as a problem — like the possible increased risk of internal distraction — may be much less wide-spread).
   - Stress that when emotionally upset, drivers make special efforts to keep their minds on their driving and to remain attentive.
   - Place added emphasis on informing new (inexperienced) drivers of the need to avoid being internally distracted (e.g., by passengers or adjustment of tape players). An emphasis on proper evasive action and retaining control may also be indicated.
   - Stress to drivers operating unfamiliar vehicles the increased risk of control loss.
   - Stress the importance when driving on unfamiliar roads of consciously reducing speed to account for unexpected, deceivingly tight or unusually slippery curves.
2. This analysis might have been improved by comparing the *presence* of these human conditions and states with the human direct causes, as well as vehicular and environmental factors. The causal judgment associated with the conditions and states in this analysis complicates interpretation and may assume too much in terms of the independence of the assessments of the direct and indirect causes (e.g., between the assessment for fatigue and cricitical non-performance/falling asleep).
3. In any future effort of this kind, interactions between the various human, vehicular, and environmental direct causes should be examined. This would promote a better understanding of the causal mechanisms.

10.1.5 Section 7.0: Analysis of Assessment Practices

1. As a part of this assessment, comparisons were made between the in-depth team's subjective (numerical) probability estimates of the causal involvement of a factor, and its application of the three assuredness labels — certain, probable, and possible — to the same factor. A general conclusion is that the in-depth team was either conservative in the use of the numerical ratings, or extravagant in the assignment of the verbal labels of at least certain

and probable causes. For example, whereas "certain" was described as having an "analogous confidence level" of 95% or better, the numerical judgments associated with that assessment had a median value of .90, with an interquartile range of between .88 and 1.00.

2. Based on the limited set of 54 drivers/vehicles considered in this assessment, there were no statistically significant differences between individual in-depth team members in their mean subjective probability assessment values, either within individual types of factors (i.e., human, environmental, or vehicle), or across all factors.

3. In addition, mean scores varied only slightly as a function of the area of expertise represented by the team member, and none of these differences were significant. In other words, team members with human factors expertise assigned neither more nor less credence on the average to the involvement of human factors (or for that matter, to the involvement of environmental or vehicular factors). Only in the case of vehicular factors was there found to be a slight (but non-significant) tendency by the engineers to assign greater weight to the involvement of vehicular factors.

4. While these analyses fall far short of a check on the external validity of the causal assessments, they are nonetheless reassuring in indicating that a consistently applied and systematic assessment procedure was used to obtain these results.

Recommendations

1. In any future effort of this kind, whenever subjective estimates of "causal involvement" are required, it is recommended that numerical probability scales be used instead of such verbal labels as "certain, probable, or possible." The use of numerical values frees the judge from narrow restrictions and provides him/her with a wider potential range of evaluations. The system has further advantages in that verbal labels may then be provided post hoc to describe any range of subjective probabilities, thus eliminating the phenomena of overlapping between subjective categories. The numerical ratings would also eliminate the observed problem of the varying correspondence obtained between verbal categories and numerical ratings for each of the different causal factor areas (e.g., human vs. vehicular).

2. The making of subjective probability judgments is a skill that must be learned, and both experience in this project and related research indicate that a person's original subjective. numerical estimates may vary significantly from either the true value or the values later estimated, after additional practice. Adequate practice and perhaps training should therefore be provided.

3. Evaluations are more accurate when people are assigned the role of estimators of component probabilities rather than estimators of product probabilities. Hence, it is probably better to have team members evaluate existence and involvement separately and then combine the product mathematically, rather than have them evaluate the derived

involvement immediately. However, training should make the judges aware of the problems of regression toward the mean, in which as the number of ratings that go into making a final evaluation increase, so do the evaluations tend to regress more and more toward the mean, making extreme values less and less likely.

4. In training accident investigators to make subjective probability judgments, one potential criterion to evaluate progress could be the independence between their evaluations of involvement and existence. Independence between the two statistics should be obtained whenever all the potential factors within a given system are considered.

5. Since speciality areas were not found to affect judgments, perhaps a psychophysical scale can be derived, using a simulator, in which forms of real or staged accidents can be used to relate the actual contribution of various potential factors to the final collision. This could be used as part of a training program and would provide investigators with benchmark probability estimates for various causal factors. To illustrate, various levels of braking deficiencies could be shown to cause an accident (given a certain time-distance relationship between cars) with varying levels of probability.

6. The evaluations here were based in part on having different people evaluate the same accident, and in part on having different people evaluate different accidents. In no case, however, were there two people representing the same area of expertise evaluating the same accident. A more scientifically sound procedure to assess future clinical evaluation processes in terms of their consistency, biases, or efficiency should involve different MDAI teams evaluating the same accidents. This can be done on an experimental basis by providing different accident investigation teams with either real or simulated accident descriptions, slides, graphs, etc. In this particular case, the use of simulated accidents or staged accidents would be an even better tool since it could also help in testing the validity of the clinical assessment procedures.

7. The "clinical assessment approach" should be carefully integrated with statistical (correlative) approaches to "causal factor"/problem identification and definition. For example, accident-causing behaviors identified through the clinical approach should then be further evaluated to better estimate the the relative risk of these behaviors through accident and control/exposure data comparisons, when possible. Similarly, statistical comparisons may identify potential problems which can then be observed and better understood through clinical observations.

8. Evaluations of any subjective assessment procedure should be conducted on an on-going basis, for use as a management tool. In this way, any unusual biases or other problems associated with a particular individual or a particular discipline can be pinpointed and remedial action taken.

10.1.6 Section 8.0: Level B vs. C Comparisons

1. In comparing results for accidents investigated separately by first an on-site and then an in-depth team, correlations (Cramer's V) between teams was less than desired — ranging from .44 across all factors to .59 for environmental factors. Disagreements resulted from both *omissions* (where in-depth cited a factor but on-site did not), and *commissions* (where the reverse was true).
2. The level of coding errors was found to be small; correction of coding errors increased correlations by an average of only .07.
3. For corrected data, correlations based on correct identifications and misidentifications only (with the commission/omission errors excluded) ranged from V = .82 for human direct causes to V = 1.00 for human conditions and states.
4. Based on definitions in this analysis, the level of *disagreements* was higher than desirable for most of the detailed causal categories. However, **it should be noted that the definitions for agreements and disagreement were exceedingly stringent**; citation of a factor at the "possible cause level" by one team, in the absence of any mention by the other team, was considered a disagreement, and a decision by both teams to *omit* (not cite) a factor was not counted as an agreement.
5. The proportion of agreements was much higher for human direct and environmental factors, than for human conditions/states and vehicular factors.
6. Of the disagreements, the most prominent were on-site omissions — particularly for human conditions and states (i.e., frequently the in-depth team cited a human condition or state at the "possible cause" level or higher, when the on-site team failed to cite the same factor at all). Note that some conditions and states may depend more than others on identification by the on-site team at the accident scene (perhaps alcohol-impairment), while others may be more readily detected off-scene by the in-depth team (possibly reduced vision as measured by the driver vision tester).
7. Further analyses were conducted employing statistics derived from signal detection theory. The pattern of results obtained indicated that, in general, on-site was relatively conservative in their citings, leading to a relatively high rate of "misses" (i.e., failures to cite factors which were judged causal by in-depth), and a very low rate of "false alarms" (citing a factor not judged causal by in-depth).
8. For vehicular factors, this analysis revealed the on-site teams to have particular problems in assessing the involvement of imbalanced brakes, suspension problems, and (possibly) the involvement of communications systems. On the other hand, on-site dealt much better with gross brake failures and degradations, as well as steering problems. Even for these factors, however, approximately 50% of the cases detected (i.e., cited at the possible level or above) by the in-depth team remained undetected by the on-site team.

9. This same analysis showed that among human direct factors, on-site did particularly well in assessing external distractions, improper lookout, and inadequate directional control, and was also reasonably accurate in tallying instances of "failing to observe and stop for a stop sign" (although this is actually not considered a "causal factor" within the IRPS scheme). On-site investigators also did an adequate job in assessing inattention, excessive speed, overcompensation, and recognition delays other than internal distraction. On the other hand, on-site was found to have difficulty in detecting the role of misjudgment of distance, improper driving techniques, inadequately defensive driving techniques, inadequate signaling, and improper evasive action. Somewhat less difficulty was experienced with respect to internal distraction, false assumption, and improper maneuver.

10. For human conditions and states, on-site performed satisfactorily (as judged by in-depth team performance) in assessing the involvement of alcohol impairment, driver inexperience, and road/area unfamiliarity. Performance was less satisfactory for other factors, and inadequate for the overall physical/physiological impairment[3] and mental/emotional stress categories.

11. For environmental factors, the on-site teams did well in assessing the involvement of control hindrances, view obstructions, and special/transient hazards. Problems were experienced in adequately detecting the involvement of slick roads, inadequate signs or signals, and highway design problems.

12. A previous comparison (discussed in *Interim Report II*) showed that based on Phase II-IV data, the reported involvement percentages for the various causal factors are generally quite similar in both on-site and in-depth data. Based on Phase II, III, and IV data, results from the in-depth and on-site levels were: human factors, 95.3 and 91.7%; environmental factors/including slick roads, 34.9 and 38.5%; and vehicular factors, 12.6 and 11.3% respectively.

13. *Interim Report II* also indicated that of the ten most frequently cited causal factors, large differences in results in the Phase II-IV data were observed for only two factors: improper driving technique (10.1% in-depth vs. 4.8% on-site), and inadequately defensive driving technique (10.1% in-depth vs. 5.0% on-site). Percentages were quite similar for the remaining eight categories.

14. However, based on an earlier agreement/disagreement analysis employing slightly different procedures and definitions, *Interim Report II* also indicated that the teams often differed as to the specific causal factors cited. It was found that the factor most consistently applied was ambient vision limitations (teams agreed in naming this factor 11.7 times as

[3] Under physical/physiological impairment, the comparatively good performance for the alcohol impairment assessment was offset by poor performance on "other drug impairment" and other physical/physiological problems.

often as they disagreed), while among the least consistently applied was improper driving technique (the teams *dis*agreed 2.7 times as often as they agreed). Again, note that an agreement by both teams that a factor was not involved was not counted as an "agreement" for purposes of these statistics (although this would have greatly improved the agreement/disagreement ratios presented).

15. As in the present analysis, *Interim Report II* indicated that the most important problems in assessing the top-ranking causal factors were that the on-site teams often failed to detect the involvement of improper evasive action, improper driving technique, and inadequately defensive driving technique, in situations where the in-depth results indicated they should.

Recommendations

1. It would have been beneficial to have continually and systematically monitored causal agreements and disagreements between teams on accidents which they both investigated, and to have used this information on an on-going basis to pinpoint problems of interpretation or use of the assessment procedure by individual teams or investigators, and to otherwise refine and improve the assessment process.

2. Were this study to be continued, immediate attention would be required in upgrading the performance of the on-site teams in evaluating the involvement of misjudgement of distance, improper driving techniques, inadequately defensive driving techniques, inadequate signaling, improper evasive action, slick roads, inadequate signs, or signals, highway design problems, imbalanced braking, suspension problems, and vehicle communication systems.

3. Further research and experimentation is in order to determine optimum team make-up and configuration, as a function of data items sought. Such work would be aimed at determining optimum numbers and assignments of team personnel; related skill, training, education, and experience requirements; as well as equipment and procedural requirements, including off-scene vs. on-scene collection and timeliness/response specifications. Trade-offs will certainly exist between numbers of cases acquired, data per case, and data accuracy. It is believed that to date, no controlled experiments or other substantial research on this subject have been conducted, which would provide an adequate scientific basis for tailoring a field collection effort to specific accident data needs.

4. Future training programs for on-site type ("level two") teams should consider including information that would explain decision theory and its implications for the different types of errors (false alarms and misses) and correct decisions (hit and misses). These should be explained within the objectives of the program so that investigators will be able to exercise influence over their criterion in evaluating the contribution of potential accident causes, whenever subjective assessments are required.

5. To the extent that the results obtained in the present analysis are valid, accident investigations at an on-site level of effort should be considered appropriate for assessing the "culpability" of drivers; but in assessing specific causes, it is recommended that either the investigator's training or evaluation criteria be changed with respect to those factors for which on-site performance was poorest (based on $d' < 1.96$ and/or hit rate = 0). These factors, labeled in the text, are 9, 14, 18, 19, 20, 21, 22, 24, 25, 34, 40, 41, 43, 45, 48, and 49.

6. Since in the process of comparing the two levels of accident investigation coding errors were found at a significant — though relatively infrequent — rate, further quality control might improve the validity of the data.

7. Further research is needed to better determine if the signal detection theory model is in fact appropriate for this type of data and application. The utilization of the SDT statistics does not necessarily imply that the accident investigator is operating as a signal detector when searching for accident causes. Some of the tests that should be conducted would involve testing of the individual "receiver operating characteristic" (ROC) curves that would indicate whether in fact the assumptions of normality and equal variance of the signal and signal plus noise distribution are warranted on an individual basis.

10.1.7 Section 9.0: Representativeness of Study Samples and Study Area

1. In this section, descriptors of Monroe County drivers, vehicles and roads were compared with available national statistics. In addition, Monroe County accident descriptors were compared with available national accident descriptors. Finally, the on-site and in-depth samples were compared with all police-reported accidents occurring in the county, and post hoc adjustments for non-uniform sampling were made to the on-site causation results.

2. The Monroe County study area — in terms of drivers, vehicles, and roadways — agreed particularly well with national data for vehicle model year, vehicle make and driver sex. It was found to differ from the nation principally with respect to driver age (younger drivers overrepresented), and road and street system mileage (proportion of municipal mileage correct, but state and U.S. highways underrepresented and county roads overrepresented). In addition, the proportion of surfaced roadways was also greater than for the nation as a whole (which is in conflict with any pre-conceived notion that the Monroe County study area is more rural or primitive than the U.S. driving environment, generally). Note, however, that causation involvement rates were found to be relatively insensitive to the non-representativeness of these variables (Volume I, Table 9-6).

3. In the comparison of reported Monroe County *accidents* to available national accident descriptors, Monroe County was found to compare particularly well as to hour of accident and type of involved vehicle, but to differ somewhat with respect to accident driver sex (women overrepresented), place of accident occurrence (rural accidents overrepresented), accident light condition (daylight overrepresented), accident type (multi-vehicle collisions

overrepresented; pedestrian, non-motor vehicle, and fixed object accidents underrepresented), road surface condition (wet roads overrepresented), accident driver age (young drivers overrepresented), and accident severity (property damage accidents overrepresented). Again, it should be noted that for each of these variables, causation involvement rates were found to be relatively insensitive to the degree of non-representativeness experienced (Volume I, Table 9-6).

4. The Phase II-V on-site sample is representative of 1972-1974 reported Monroe County accidents (i.e., does not vary to a statistically significant extent) in terms of place of occurrence (urban or rural), driver sex, and driver age. The most non-representative characteristics are light conditions (on-site sample overrepresented daylight accidents); road surface condition (overrepresented accidents which occurred on dry road surfaces); weather conditions (overrepresented clear conditions); hour of accident (overrepresented accidents occurring between noon and 3:59 p.m.); character of location (underrepresented open road, non-intersection accidents); investigation source (underrepresented non-police reported accidents — expected since only police-investigated accidents met the criteria for investigation); and arrest status (overrepresented drivers who were not arrested). Note that with the exception of investigation source, the effects of non-representativeness of each of these variables has been examined and found to be extremely insignificant in terms of overall involvement of human, vehicular, and environmental factors.

5. The Phase II-V in-depth sample was found to be representative of the 1972-1974 reported Monroe County accidents (again, in the sense of not varying to a statistically significant extent) with respect to weather conditions, character of location, road surface condition, driver license status, and driver sex. The most non-representative characteristics of the Phase II-V in-depth accidents are light conditions (in-depth sample overrepresented daylight accidents); hour of accident (overrepresented accidents occurring from noon to 3:59 p.m.); accident type (overrepresented non-collision/running off road accidents); investigation source (underrepresented accidents not investigated by police agencies — again, an artifact of the selection criteria that only police-investigated accidents were considered); and arrest status (overrepresented drivers who were not arrested). Again, these differences have been found to have only a minor or insignificant effect on the aggregate causal result percentages (Volume I, Table 9-6).

6. While the effects of nonrepresentativeness on the specific, detail level causal factors were not examined, from the data presented in Volume I, Section 3.2.3, it is evident that results regarding the involvement of alcohol-impairment as an accident cause varied as a function of the extent of coverage provided (i.e., according to whether accidents were selected from all hours of the day or only from limited periods). The overall effects of hours of coverage on alcohol-impairment are not clear (Volume I, Figure 3-5). However, for on-site team results (which are probably less influenced by selection biases arising from non-cooperation of drinking drivers), more frequent involvement was consistently recorded during 24-hour per

day coverage than during periods of limited coverage (from 11:30 a.m. to 10:30 p.m.). This would indicate a greater involvement of alcohol-impairment in late night and early morning accidents. Overall, since 24-hour per day coverage was not provided continually throughout Phases II-V, this would indicate that the aggregate results for alcohol-impairment in Phases II-V are understated.

7. Overall, considering the degree of representativeness of Monroe County and the IRPS accident samples, as well as the effects of non-uniform sampling on estimates of causal involvement, it is concluded that the study area and samples are adequate to provide reasonable and useful estimates of the relative involvement of the kinds of human, vehicular, and environmental factors assessed.

Recommendations

1. Although the relationships were not strong and the effects of non-uniform sampling on IRPS' aggregate results were quite small, the accident causation judgments were shown to be related to various accident, driver, vehicular, and environmental descriptors. This means that estimates regarding the role of the various human, vehicular, and environmental factors can be inaccurate if the samples are chosen incorrectly, or if adequate post hoc adjustments are not made.

2. With this in mind, it is recommended that when clinical assessment procedures are used in the future, samples to be chosen to minimize potential biases on these causal assessments, and that adjustments be made to the aggregate measures of involvement, in order to minimize the influence of non-representative samples. Most likely some post hoc numerical adjustments will be required, since inevitably some drivers either cannot or will not cooperate, creating the likelihood that certain situations will be improperly represented. These kinds of situations can occur when drivers are worried about future litigation, reside far from the study area, or are fatally injured. Where possible, extra effort should be exerted to assure that some of the "non-cooperatives" in fact are sampled (i.e., that there is penetration of the nonresponse groups). In addition, police reports on accidents involving uncooperative drivers should be compared to similar data collected for the volunteer drivers, in order to detect and account for any systematic bias. At a minimum, variables which have been shown to influence causation estimates should be considered when sampling procedures are developed. These are as follows:

   - Estimates of human involvement in accidents will be understated if the following are undersampled: arrested drivers; non-licensed or out-of-state drivers; urban accidents; dry or wet road surface accidents; dawn or dusk accidents; and accidents occurring between 8:00 a.m. and 7:59 p.m. Human involvement will also be understated if the following are oversampled: drivers aged 25-64; multiple vehicle accidents; and motorcycle accidents.

   - Environmental involvement will be understated if the following are undersampled: single vehicle accidents; accidents during rainy, snowy, or foggy weather conditions; rural accidents; accidents on wet, or snow/ice covered roads; and non-intersection accidents.

- Estimates of vehicular involvement in accidents will be understated if the following are undersampled: drivers under 20 years of age; single vehicle accidents; or accidents occurring on wet road surfaces.

10.2 Volume II: Special Analyses

10.2.1 Section 2.0: Driver Attributes and Relationship to Accident Causation

10.2.1.1 Section 2.1: Driver Vision Testing

1. A Driver Vision Test (DVT) which is an integrated battery of 12 different driving-related tests, covering such visual skills as acuity for static and dynamic targets, visual field, and dynamic movement detection thresholds, was administered both to drivers who had been involved in accidents and a non-accident control group.

2. It was found that test/re-test correlations were statistically significant for most of these 12 separate tests, but were adequately high on only three tests: (1) static acuity in normal illumination; (2) static acuity in the presence of spot glare; and (3) dynamic visual acuity.

3. Given the 30 to 40 minute administration time, the DVT was found unduly time consuming for use in routine driver licensing, in its present configuration. However, investigations were made which suggest that for licensing purposes the DVT could be significantly shortened. For example, results show that all four tests of static foveal acuity correlated with each other more than with any of the other tests, and dynamic visual acuity correlated highly with most of the measures reflecting movement threshold acuity. Some of these tests may therefore be deleted.

4. Dynamic Visual Acuity (DVA) was found to be the test which best discriminated between accident at-fault drivers and a control group of non-accident drivers, once the effects of age were controlled for.

5. In another analysis, drivers who were judged to have committed accident-causing recognition errors were compared with those who had committed other errors, and with those who were involved in accidents but had committed no errors. The drivers who had committed recognition errors scored significantly poorer on the test of static acuity under low levels of illumination, than drivers who had committed no errors (20/88 vs. 20/75). Drivers who had committed "other errors" also scored more poorly than no-error drivers.

6. A separate analysis was performed examining measures hypothesized to have particular relevance to involvement in either right angle or rear-end collisions. As hypothesized, it was found that increased involvement in right angle collisions was associated with lower

sensitivity to peripheral movement in-depth. Less clearly, it appeared that involvement in rear-end collisions increased as the ability to detect angular movement in the central visual field decreased. For those with poor dynamic visual acuity — which by far was the visual ability found to be most consistently related to accidents — there was increased involvement in both right angle and rear-end collisions, with the increase in the rear-end configuration being somewhat greater.

7. Of the more reliable measures provided by the DVT in its present form, **dynamic visual acuity** appears to be the only variable which is consistently and significantly related to accident involvement. Static acuity under normal illumination — presently the only visual screening criterion in most licensing tests — was not shown to be causally-related to accidents (with the particular device and procedures used in this study). The importance of most other measures of visual performance (e.g., static acuity under low levels of illumination and peripheral movement in-depth for large targets) cannot be adequately determined before the reliability of these measures is improved.

Recommendations

1. Results suggest that the DVT is adequate for testing foveal static acuity under normal and glare conditions, but is less than satisfactory in measuring static acuity under low levels of illumination — unless a sufficient dark adaptation period is provided. The DVT does, however, yield a stable measure of dynamic visual acuity and effective visual field.

2. The present administration and scoring procedures render measures of both central and peripheral movement detection too unreliable to be useful; accordingly, improvements are required in these areas.

3. For licensing purposes, the DVT requires too much time in its present configuration, and the equipment is excessively bulky as compared to devices presently in use. It is recommended that improvements can be made in both respects by retaining only tests found to be definitely related to driving ability, and which are independent of each other. The factor analysis and various validity analyses suggest that two candidate tests for a reduced battery are: (1) foveal static acuity (under low level illumination), and (2) dynamic visual acuity.

4. Before such recommendations are implemented, the unreliable tests must be improved. This is necessary before any definite conclusions about relevance to driving ability and accident avoidance can be reached. The pattern of results suggests that such improvements can be achieved by increasing the mechanical reliability of the DVT on one hand, and the objectivity of the scoring procedures on the other. Such methodological improvements in a modified and improved version of the DVT are currently being pursued under another NHTSA-sponsored contract.

10.2.1.2 Section 2.2: Driver Knowledge Testing

1. An analysis was undertaken to determine the usefulness of a particular driver knowledge test as an indicant of accident involvement or type of driving error. A 20-question driving knowledge test was constructed from a large pool of multiple choice items provided by NHTSA, along with nine supplementary questions provided by IRPS. The questionnaire was administered to 178 drivers from an accident group and 133 drivers from a control group.

2. Driver knowledge test scores varied significantly as a function of age. Drivers under 20 years of age scored relatively low. Drivers 20 to 34 scored the highest, but with a deterioration of scores beginning at age 35 and continuing, such that drivers 65 years of age and over scored the lowest.

3. Of the 20 questions, males performed significantly better on four questions, and marginally better on an additional two. Females performed marginally better on one of the questions. In terms of total test score, males scored significantly higher. The questions best answered by males appeared to concentrate on handling in emergencies and mechanical considerations, rather than on general driving style or laws.

4. As might have been expected, those who had received formal driver training scored significantly better than those who had not. The questions best answered by those who had had driver training emphasized general driving style and laws rather than emergency handling or mechanics.

5. In a separate analysis, a comparison was made among the test scores of those judged at fault in accidents, those involved but not-at-fault, and a control group of non-accident drivers; no statistically significant differences were identified for any of the individual questions, or for total driver knowledge test score. Consequently, this analysis provides no support for the idea that driver knowledge (as measured by this test) is related to accident involvement. One problem with this evaluation, however, was that in the time which elapsed between the accident and the knowledge test, drivers committing certain errors may have learned through discussions of the accident with friends, parents, their insurance company, etc.

6. In yet another analysis, relationships were examined between particular questions and the incidence of accident-causing behaviors or problems which were hypothesized as being possibly related to them. Again, no statistically significant relationships were identified.

Recommendations

1. Despite the discouraging results obtained here, it is highly unlikely that all aspects of driving performance are unrelated to the content areas and driving skill requirements which have been previously identified. Apparently, when driving performance is measured by accident involvement, other skills and knowledge than that measured by this knowledge test is

relevant. In the future, more specific and relevant definitions of driver knowledge should be tested.

2. Accordingly, one recommendation is that driver knowledge should be tested in the behavioral areas that have been determined to be the major causes of accidents, and that this testing should take place immediately following the accident — before any additional learning takes place. Questions that assess proper visual surveillance techniques, awareness of the risk of inattention, proper evasive maneuvers, etc., are possibly more directly relevant to accident avoidance than questions dealing with maintenance, driving style, or knowledge of traffic regulations.

3. In addition, driver knowledge of accident avoidance maneuvers should be tested under temporal stress. The drivers frequently reported that they "knew" that they had performed an inappropriate avoidance maneuver, but in the limited time available had responded "instinctively." When taking the knowledge test, these drivers often answered related questions appropriately. Hence the need to measure both whether drivers know the right answer, and how much time is needed to reach the correct decision. Perhaps testing could be conducted in an active simulation environment, in which the driver is required to actually perform the appropriate motor response.

10.2.1.3 Section 2.3: Methodology Development — New Driver Measures

1. This section built on previous research aimed at ascertaining distinguishable characteristics of the overinvolved or "problem driver." Driver characteristics and traits (independent variables) such as prior record, alcohol/drug usage, social adjustment, personal adjustment, and impulse control were examined in terms of their relationship to various on-road behaviors (dependent variables) characteristic of risk-taking, poor decision making, and poor perceptual-motor skill.

2. In a preliminary study, a group of young accident repeaters was compared with a matched group of non-accident drivers, in terms of alcohol/drug use, personal adjustment, social adjustment, impulsivity and clerical ability. The high-accident group scored reliably higher on measures of alcohol/drug use, and on one or more measures of personal maladjustment, social maladjustment, impulsivity, and clerical speed/accuracy. The discriminant function was able to correctly assign 42 of the 46 matched subjects (i.e., over 90%).

3. In a second validation study comparing new groups of high and non-accident young drivers, the discriminant function from the original study correctly assigned 12 of 14 matched subjects (i.e., over 85%). This study substantiated the validity of these measures of social and personal adjustment, at least for the type of young licensed drivers studied.

4. Results of the original and validation studies were combined and further analyzed,

providing a total N of 60 licensed college freshmen, ages 18 and 19. Results from these analyses are consistent with the idea that personal maladjustment (i.e., problems with one's self) and social maladjustment (i.e., problems with society) are related to accident involvement. To a lesser extent cognitive abilities (e.g., clerical abilities) and impulsivity are also related to accidents.

5. In a separate analysis, a comparison was made between drivers judged to have committed an error and those who were error-free. It was found that drivers who had committed errors tended to score higher in both personal and social maladjustment (i.e., were more maladjusted). In a subsequent analysis, scores were compared among drivers who had committed a recognition error, a non-recognition error, or were error-free. Marginally reliable differences were obtained, with the no-error group scoring best on personal and social adjustment, while the "other-error" group scored worse than the recognition error group. Thus, the scales tested were not able to predict type of error, but did appear related to accident causation.

6. A subsequent analysis was performed to better determine the relationship of these "driver profile scores" to specific types of driving errors. This analysis showed that:

   - Drivers who were cited for any causative human factor, especially a human condition/state, alcohol-impairment, or inattention, were more personally maladjusted than the no-error controls. One hypothesis is that personal problems may preoccupy or distract the driver.

   - Drivers committing almost any error, especially recognition and decision errors (and possibly those cited for alcohol-impairment), were more anti-social than controls. Possibly socially maladjusted drivers may make a conscious decision to drive more recklessly.

   - Drivers cited for causally-relevant alcohol-impairment tended to lack impulse control. These three sets of findings suggest that personal maladjustment, social maladjustment and lack of impulse control may all be factors underlying accident involvement by reason of alcohol impairment. Further research is needed to clarify this point.

Recommendations

1. Results are highly encouraging for the idea that high accident drivers differ from no accident drivers, as a group, and are promising in their support of several theoretical notions concerning the differences. This is true despite the last three of these related studies being based on information which had been previously collected in the course of in-depth (Level C) investigations. (Existing questions on the in-depth human factors form were used to form ad-hoc scales for measures such as personal and social maladjustment). This leads to the recommendation that the five-step sequence as proposed in the text be pursued.

2. A recommended next step would be initiation of a prospective study in which an entire battery of questions specifically designed around these scales are given to a stratified, representative sample of the general driving population, for comparison with data on their previous crashes and violations. The fifth and concluding step would involve a major study in which the entire revised battery is administered to a representative sample of accident-involved drivers, in order to examine in detail the extent to which different types of accident causing behaviors are related to different basic human traits. A follow-up study would then monitor driver records for a future period to determine the predictive validity of the measures used.

10.2.1.4 Section 2.4: Driver Characteristics and Culpability

1. In this section, accident-involved drivers which IRPS investigators assessed as having committed errors (i.e., "culpable drivers"), were compared with non-culpable accident drivers in terms of their age, sex, driving experience, vehicle familiarity, annual mileage, and road/area familiarity.
2. Based on this analysis, it was found that for both men and women, culpable drivers had significantly less road/area familiarity than did non-culpable drivers.
3. Non-culpable men, in addition to having significantly more road/area familiarity, were characterized as having more familiarity with their vehicles than would be expected for their age, and as being between the ages of 35-54. Culpable men were characterized as having little road/area familiarity, having less familiarity with their vehicles than would be expected for their age, and as being either young (15 to 19) or old (over 64).
4. In addition to having significantly more road/area familiarity, non-culpable female drivers were characterized as having more driving experience than would be expected for their age, and as being either over 54 or between 35 and 44 years of age. Culpable female drivers were characterized as having little road/area familiarity, an intermediate (moderate) level of driving experience for their age, and as being either under 25 or between the ages of 45 and 54.

Recommendations

This analysis has been conducted in such a manner that differences between drivers arising out of relatively uncontrollable risks (such as annual miles traveled by the different groups) have been controlled for, so that the differences which remain can be assumed to be accounted for primarily by "unsafe driving practices." It is therefore recommended that drivers be provided with information sufficient to let them know if and when they are falling into one of these unsafe, "high culpability" groups or situations, and that further research be conducted to determine exactly what kinds of driving behaviors or practices are involved, leading to the increased risk.[4]

10.2.2 Section 3.0: Special Analyses: Human, Vehicular, and Environmental Characteristics in Accident Causation

10.2.2.1 Section 3.1: Cluster Analysis

1. In this section, information regarding a sample of 353 of the drivers/vehicle units involved in accidents investigated in-depth (Phases II-V), were used as inputs to a cluster analysis. In this manner, the *drivers which were most similar on the basis of causation variables were* grouped together, and differences between groups in terms of other variables (such as driver knowledge, vision, and personal adjustment), were measured.
2. Results of the cluster analysis of the causal hierarchy indicate that the investigators used the hierarchy consistently, in that there were clear groupings or clusters of drivers/vehicles. These "natural" groupings tended to set apart drivers in terms of whether they had made decision errors, recognition errors, or were "not-at-fault," and in terms of whether environmental factors or human conditions and states had been assigned as causally-relevant to them. This pattern is consistent with the causal factor hierarchy. While the initial groupings were produced using 353 drivers from the in-depth file, in 14 separate random samplings of 200 driver/vehicle units from the on-site file, a similar cluster structure consistently emerged (up to and including the five-cluster level).
3. Comparisons were made between a number of the clusters, in order to measure differences on additional descriptors which had not been used in the formation of the clusters. For example, the members of the largest cluster (n = 133), none of whom had committed any assignable error, were compared with combined members of the seven remaining at-fault clusters. Significant differences were identified for nine of the 29 variables compared; for example, members of the not-at-fault cluster scored significantly better in terms of both dynamic visual acuity and social adjustment. Differences were not significant with respect to driver knowledge test score, reaction time, socio-economic status, personal adjustment, alcohol usage, prior driving record, or age. On the other hand (as might be expected from the discussion on the confounding of age and vision in Section 2.1 of Volume II), the not-at-fault drivers scored more poorly on static acuity and, unexpectedly, on impulse control.
4. This and other inter-cluster comparisons demonstrated that the grouping of drivers into such clusters was informative in terms of additional driver attributes not used in the process of deriving the clusters.

[4] Further analyses have been conducted regarding types of unsafe driving practices associated with these driver groups, as a part of the "Tri-Level Study of the Causes of Traffic Accidents," Modification for Special Data Analyses, Task 4."

10.2.2.2 Section 3.2: AID Analysis

1. In the automatic interaction detector (AID) analysis, the absence or presence of a variety of causal factors was the dependent variable, and the independent variables were 10 selected driver demographic and environmental characteristics.

2. Based on the AID analysis, road/area familiarity emerged as an extremely important variable; the human factors summary, a variable that indicates whether or not a particular driver was identified as having committed *any* attributable error, split first on the road familiarity descriptor, indicating that this was the most important descriptor in differentiating drivers who made errors from those who did not. One or more human causal factors was assigned for 69% of those who were unfamiliar with the road (i.e., drove it less than once per week), but for only 53% of those who drove the road once per week or more frequently.

3. The most frequently implicated human causal factors in the IRPS hierarchy were divided between either of two broad categories — recognition errors or decision errors. With *recognition errors* as the dependent variable, the sole split occurred (as for the human factors summary) on the road familiarity variable, with drivers who were more familiar with the road being less likely to have committed a recognition error. With *decision errors* as the dependent variable, however, an entirely different split occurred based on traffic volume at the time of the accident; decision errors were cited for 36% of the drivers who had accidents in "light traffic," but for only 27% in moderate or heavy traffic. However, as one might expect, decision errors were cited more frequently among drivers who were unfamiliar with the road. In addition, drivers between the ages of 25 and 64 were much less likely to be cited for decision errors than either young drivers or drivers 64 and over. Since the "excessive speed" category comprises a large proportion of all factors occurring under the decision errors heading, the rationale for the excessive speed split in large measure explains the decision error split (see below).

4. For the most frequently-implicated causal factor — improper lookout — road familiarity and driver age were close competitors to split the overall sample, with road familiarity actually producing the split. Drivers who were unfamiliar with the road, or who were 65 years of age or older, were substantially more likely than other drivers to have committed an improper lookout error.

5. For the second-ranking causal factor — excessive speed — the initial split occurred for traffic volume (as it did for the decision errors category of which it is the largest component), with excessive speed being cited for slightly under 5% of drivers in moderate or heavy traffic, but for nearly 14% of drivers in light traffic. This result could have been anticipated, since it is consistent with conditions which provide an opportunity to speed. In addition, young drivers were found nearly three times as likely as drivers 20 or older to be cited for excessive speed; males were twice as likely as females; less experienced drivers

(those with two years or less driving experience) were roughly two and one-half times as likely as more experienced drivers; and those who were relatively unfamiliar with their vehicle were roughly twice as likely as those who were more familiar.

6. For vehicular causal factors overall, the possible initial splits were pavement condition (dry, wet, snow, slush, or ice covered), precipitation intensity, driver age, and driving experience, with the split actually occurring for pavement condition; vehicular factors were cited as causes in 8.0% of accidents occurring on "wet" pavement, compared to 3.5% in accidents occuring on "dry, icy, or snowy" pavement. The high identification rates for wet pavement and precipitation are consistent with the fact that a majority of the vehicular factors were related to either tires or brakes — problems which would be greatly intensified by environmental factors that might increase stopping distances or reduce traction laterally.

Recommendations

1. Low road familiarity appeared related to the commission of a broad range of human causal errors, and further research is warranted to better identify reasons for this problem, as well as ways to alleviate it. For example, it might be possible to identify discrete components of familiarity in perceptual and behavioral terms, leading to design of training programs which would teach drivers to learn more rapidly the relevant information from a new road. Equally, new signing and/or roadway design requirements might be desirable, to better "cue" drivers as to roadway alignment changes and related needs for speed adjustment. Other aspects of the problem may lie in either program management or funding. For example, it may be that an adequate system to identify locations needing warning signs, and to periodically check these locations and perform needed replacement or maintenance, has not been provided. In other cases, the need may be known, but funds may not be adequate to provide such signing.

2. Even with 2,433 accident driver/vehicle combinations (with no missing data) available from the IRPS on-site investigation level for this analysis, the decomposition of the sample into subparts quickly produced relatively small groups of interest that could not be adequately studied or further decomposed due to their small size. It is therefore important that future national data collection efforts incorporate an easily and consistently applied "causal assessment" scheme to aggregate additional cases and thereby increase the ability of researchers to analyze relatively large subgroups of these categories.

10.2.3 Section 4.0: Motorcycle Accidents and Causes

1. In this section, three separate analyses were conducted: (1) an assessment of differences between accidents involving motorcycles and those involving other types of vehicles; (2) a

comparison of the 52 motorcycle accidents investigated by IRPS as a part of the "Tri-Level Study" with those reported state-wide by the Indiana State Police in 1973; and (3) an analysis of the 52 accidents investigated by IRPS in terms of causes assessed for both the motorcycles and the other involved vehicles.

2. As compared to reported accidents involving other types of vehicles, motorcycle accidents were more frequently single vehicle, rural, and non-intersection; occurred more frequently during the warmer months and on weekends; were more likely to occur during the afternoon or evening (rather than in the morning or early morning hours); more frequently occurred on dry road surfaces; and were more frequently injury-producing. The accident-involved motorcyclists were younger than drivers of other accident-involved vehicles, and were more frequently male. However, there was no recorded difference between motorcyclists and other accident-involved drivers with respect to the (police-recorded) presence of alcohol.

3. The 52 motorcycle accidents investigated by IRPS during the five yearly study phases were representative of all 1973 Indiana State Police-reported motorcycle accidents with respect to accident configuration, severity, place of occurrence, month, day of week, time of day, road surface condition, and light conditions. IRPS accident-involved motorcyclists were representative with respect to sex and presence of alcohol, but overrepresented the 20-34 year age group, and underrepresented motorcyclists less than 20.

4. Primary causes assessed for the 52 motorcyclists were human decision errors and environmental factors. The most frequent decision error was excessive speed, followed by false assumption and improper driving technique. The most frequent environmental factors for motorcyclists were view obstructions (e.g., hillcrests and sags), followed by slick roads and special hazards (primarily non-contact vehicles).

5. Other motorists in motorcycle accidents (i.e., drivers of other vehicles which collided with motorcycles), were most frequently assigned recognition errors (i.e., failure to recognize an oncoming motorcycle), decision errors, and environmental factors. Many recognition errors occurred when entering a travel lane from an intersecting street or alley. These involved inattention to other traffic, improper lookout, and "other delays in perception." Another frequent recognition error was internal distraction (e.g., conversation with a passenger). The most prevalent decision error was improper maneuver (e.g., turn from wrong lane), while view obstructions (e.g., other parked vehicles), were the most frequent environmental causes.

6. As compared to all other accident-involved drivers, motorcyclists in the IRPS sample were less frequently cited for human errors, made significantly fewer recognition errors, and had fewer accident-causing vehicle malfunctions.

7. On the other hand, as compared to accident-involved drivers generally, the drivers of

vehicles striking motorcycles in the IRPS sample were more frequently culpable, made significantly more recognition errors, made significantly fewer decision errors, and were less likely to be affected by adverse physiological/psychological states (e.g., alcohol impairment was less frequently involved than for accident-involved drivers generally).

8. In summary, a major problem is that other motorists often fail to see oncoming motorcyclists, particularly at intersections. The striking "other vehicle" driver is less likely to be involved by reason of alcohol-impairment than are accident drivers generally, while for motorcyclists it appears that alcohol involvement is neither more nor less frequent than for accident drivers generally.

Recommendations

Obviously a much larger data base than the 52 motorcycle accidents examined by IRPS would be required to confidently list the related problems and to provide adequate guidance to such countermeasures as driver education, vehicle inspection, or vehicle design. However, these results can be used to help inform motorcyclists of the danger that other drivers will fail to see them, and to underscore the importance of keeping the headlight on, wearing highly visible clothing, and decreasing speed at intersections.

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CAUSAL FACTORS GLOSSARY

Section Organization:

Chart of Top-level Breakdown of Causal Factors

I. Human Direct Causes
   1. Organizational Chart
   2. Outline of Factors
   3. Definitions

II. Human Conditions and States
   1. Organizational Chart
   2. Outline of Factors
   3. Definitions

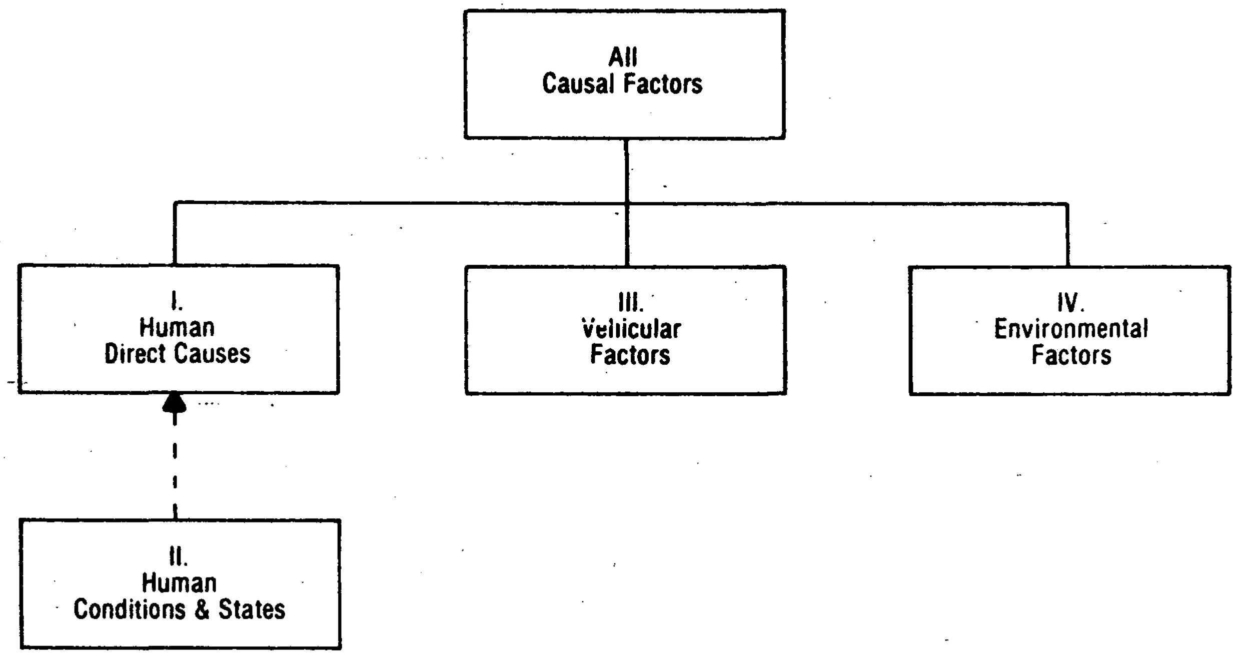
III. Environmental Factors
   1. Organizational Chart
   2. Outline of Factors
   3. Definitions

IV. Vehicular Factors
   1. Organizational Chart
   2. Outline of Factors
   3. Definitions

NOTE: Several of the human condition and state definitions were taken directly, or with minimal changes, from a Cornell Aeronautical Laboratories, Inc., report by K. Tharp, T. Calderwood, J. Downing, J. Fell, J. Garrett, and E. Mudrowsky, entitled "Multidisciplinary Investigations to Determine Automobile Accident Causation: Findings," March 1970 (CAL Report No. VJ-2224-V-4). These factors are identified in the human conditions and states definition by the parenthetical notation of (CAL) at the end of applicable definitions.

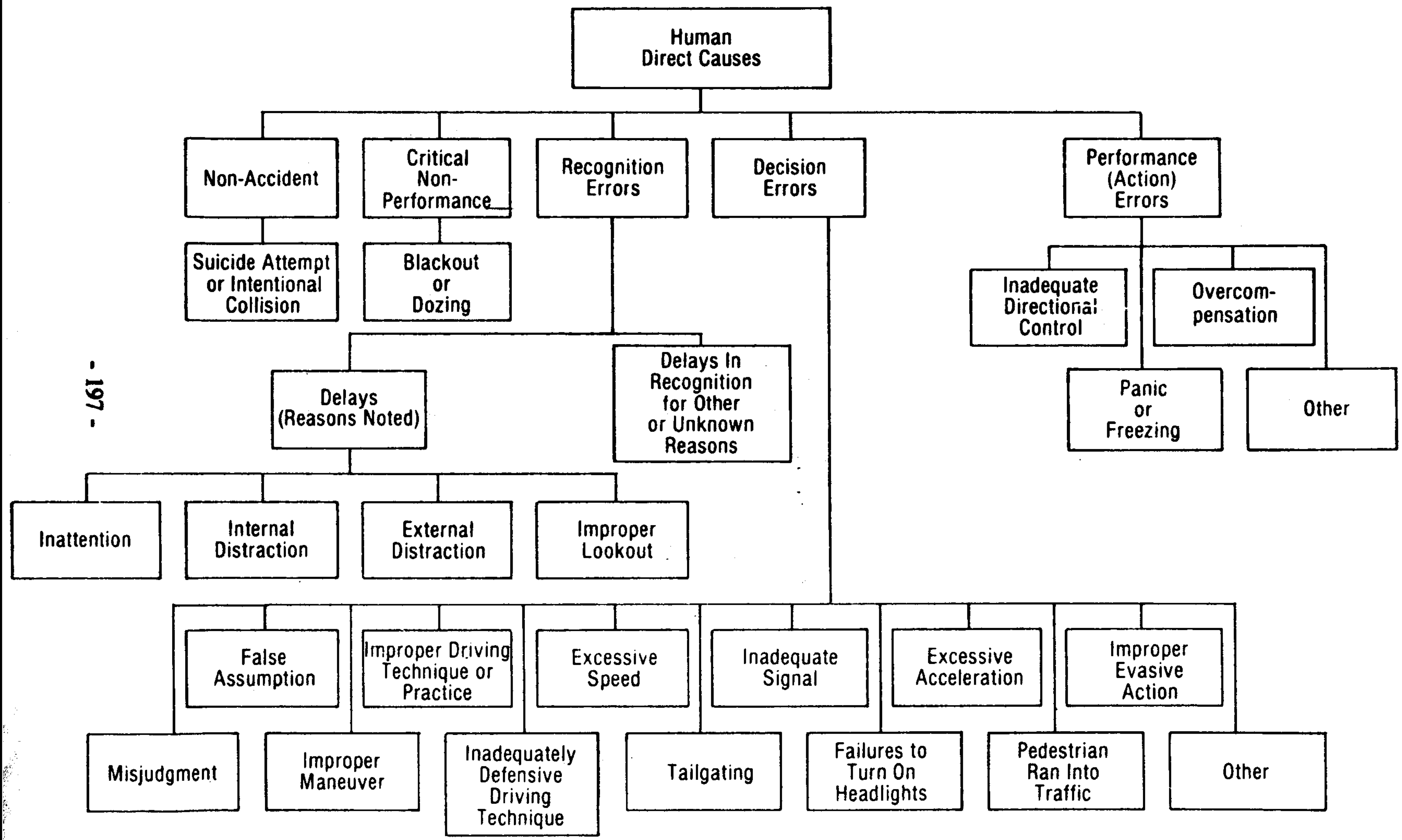
Glossary Figure 1

Top-Level Breakdown of Causal Factors



Glossary Figure 2

Causal Factor Tree for Human Direct Causes



Outline

I. Human Direct Causes

A. Critical non-performance

1. Blackout
2. Dozing

B. Non-accidents—(suicide attempts, etc.)

C. Recognition Errors

1. Driver failed to observe and stop for stop sign (special interest category)
2. Delays in recognition (reasons noted)

(a) Inattention

(1) To traffic stopped or slowing ahead
(2) To position of car on road
(3) To road features, such as on-coming curves, lane narrowing, etc.
(4) To road signs or signals providing driver information
(5) To cross-flowing traffic, such as merging or intersecting traffic
(6) Other

(b) Internal distraction

(1) Event in car (e.g., loud noise, yell, scream, sick passenger, dropped cigarette, fire)
(2) Adjusting radio or tape player
(3) Adjusting window, vent, heater, or similar control
(4) Conversation with passenger
(5) Other

(c) External distraction

(1) Other traffic
(2) Driver-selected outside activity (e.g., looking for house number, looking for street signs, examining particular property, etc.)
(3) Activity of special interest (e.g., fight, girl in bikini, accident, fire, etc.)
(4) Sudden event; loud noise, explosion, flash of light, sudden screech, etc.
(5) Other

(d) Improper lookout

(1) Pulling out from parking place
(2) Entering travel lane from intersecting street, alley, intersection
(3) Prior to changing lanes or passing
(4) Other

3. Delays in Recognition (for other or unknown reasons)

(a) Of traffic stopped or slowing ahead
(b) Of position of car on road
(c) Of road features, such as on-coming curves, lane narrowing, etc.
(d) Of road signs or signals providing driver information
(e) Of cross-flowing traffic, such as merging traffic or intersecting traffic
(f) Other

D. Decision errors

1. Misjudgment (of distance, closure-rate, etc.)
2. False assumption

(a) Assumed other driver had to stop or yield at intersection
(b) Assumed other driver would stop or yield at intersection without assuming traffic control
(c) Assumed on-coming car would move left or right, out of way
(d) Assumed vehicle was going to make a turning maneuver, which it did not
(e) Assumed there was no traffic coming (or that traffic was stopped) when in fact there was traffic coming
(f) Other

3. Improper maneuver

(a) Turned from wrong lane or position
(b) Drove in wrong lane but correct direction (e.g., went straight in turn lane)
(c) Drove in wrong direction of travel for lane (e.g., one-way street)
(d) Passed at improper location
(e) Other

4. Improper driving technique or practice

(a) Cresting hills driving in center of road
(b) Braking later than should have or at inappropriate location
(c) Stopping too far out in road or intersection
(d) Driving excessively close to center line or edge of road

(e) Slowed too rapidly (e.g., slammed on brakes to make turn at last minute)
(f) Other

5. Inadequately defensive driving technique

(a) Strategic error—should have positioned car differently in anticipation of possible problems
(b) Strategic error—should have adjusted speed in anticipation of possible problems
(c) Strategic error—should not have taken other driver's obedience of traffic signal for granted
(d) Other

6. Excessive speed

(a) For road design—regardless of condition or traffic
(b) Solely in light of traffic, pedestrians, number of accesses, etc.
(c) Solely in light of weather conditions (including slick roads)
(d) Due to combinations of above
(e) Other

7. Tailgating

8. Inadequate signal

(a) Failure to signal for turn
(b) Failure to use horn to warn
(c) Other

9. Failure to turn on headlights
10. Excessive acceleration
11. Pedestrian ran into traffic
12. Improper evasive action

(a) Locked brakes/could not steer
(b) Above does not apply, but driver could have steered out of danger and did not
(c) Driver could have accelerated out of danger but did not
(d) Other or unspecified

E. Performance errors

1. Overcompensation
2. Panic or freezing

3. Inadequate directional control

   (a) On-curve—allowed car to enter opposing lane of travel
   (b) On straight—allowed car to enter opposing lane of travel
   (c) On straight or curve—allowed car to go off road edge to right

F. Other Human Causal Factors

Definitions

I. Human Causal Factors (Direct Causes)

This heading comprises one of the three main groups into which all accident-causative factors are separated—*human, vehicular,* and *environmental.* This category refers to all human acts and failures to act in the minutes immediately preceding an accident, which increase the risk of collision beyond that which would have existed for a conscious driver driving to a high but reasonable standard of good defensive driving practice. Thus, the failure of a driver, engaged in animated conversation, to notice that the car in front of him has stopped, is categorized as a *human causal factor* for purposes of this study. However, the improper repair activities of a driver, which several minutes later result in a catastrophic brake failure, are not categorized as human causal factors for purposes of this study. That failure would be classified as a *vehicular factor,* though the human error involved would be noted in the case report on the accident.

A. Critical non-performances

This refers to a situation where a driver loses consciousness, either in the sense of blacking-out or falling asleep, and as a result is involved in an accident. These are termed critical non-performances in the sense that a catastrophic interruption in the driver's performance as an information-processor occurs, and he drops totally out of the information-processing system.

B. Non-accident

This refers to situations where collision is intentional. It thus includes both suicide attempts, and a situation where a driver, annoyed by the proximity of a following vehicle, slams on his brakes in anger, and as an inevitable result, is rear-ended.

C. Recognition errors

This category heading includes the next-level (more specific) categories designated *inattention, internal distraction, external distraction, improper lookout,* and *other* *delays in perception, comprehension or reaction.* To a large extent, it is defined by the categories which comprise it.

This category intends to include all situations where a conscious driver does not properly perceive, comprehend, and/or react to a situation requiring adjustment of speed or path of travel for safe completion of the driving task.

1. Driver .led to observe and stop for stop sign

   This category is unique among others presented in that it does not define what is considered for purposes of this study to be a causative driver error. Instead, it is used merely to tally cases where driver errors had a particular result. It is thus often not mutually exclusive of other categories.

   This category applies whenever a conscious driver for any reason fails to notice a stop sign which should have been visible to him, and is as a result involved in an accident because of not stopping for that stop sign. This category was developed because this particular type of accident was noted to occur frequently.

2. Delays in recognition (reasons noted)

   This refers to all *recognition errors*, as previously defined, for which specific explanations or reasons were determined. These reasons include *inattention, external distraction, internal distraction,* and *improper lookout.*

   (a) Inattention (preoccupation)

   This category applies whenever a driver is delayed in the recognition of information needed to safely accomplish the driving task, because of having chosen to direct his attention elsewhere for some *non-compelling reason.* Specifically excluded from this category are cases where a circumstance or event compels or tends to induce a shift away from the driving-task matters requiring attention. The category thus denotes an unnecessary wandering of the mind, or a state of being engrossed in thought in matters not of immediate importance to the driving task.

   A d·iver may be inattentive to traffic stopping or slowing ahead; to the position of his car on the road; to features such as on-coming curves, lane narrowings, etc.; to road signs or signals providing driver information; or to cross-flowing traffic; such as merging or intersecting traffic.

   Inattention is to be distinguished from the *distraction* categories, wherein a circumstance *compels* or tends to induce a shifting of attention away from the driving task, and from the *improper and/or inadequate lookout* category, wherein the driver encounters situations requiring a distinct visual surveillance activity (in addition to that which is always required), for safe completion of the driving task.

(b) Internal distraction

This category applies whenever a driver is delayed in the recognition of information needed to safely accomplish the driving task, because some *event, activity, object,* or *person within his vehicle, compelled* or tended to induce the driver's shifting of attention away from the driving task; a radio might act as an object of special attention, tending to induce the driver to shift his attention from the driving task to adjustment of the radio. Conversation with a passenger which diverts attention from the driving task is considered an internal distraction.

Examples of events or activities which are ordinarily considered internal distractions include sudden or unusual events in the car such as loud noises, yells, a sick passenger, or a dropped cigarette, and mechanisms requiring driver-adjustment, such as radios, tape players, windows, and heaters.

Inattention is to be distinguished from the *inattention (preoccupation)* category, wherein a driver shifts his attention from the driving task, but no event, activity, or object compels or tends to induce such a shift. Mere driver-chosen mental activity falls under the inattention category, rather than internal distraction.

Internal distraction is particularly to be distinguished from *improper lookout,* in that *internal distraction* takes precedence over *improper lookout.* Thus, if a driver's lookout is inadequate or improper and this is due to an internal distraction, only the internal distraction category will apply.

(c) External distraction

This category applies whenever a driver is delayed in his recognition of information needed to safely accomplish the driving task, because an *event, activity, object,* or *person* outside his vehicle *compelled,* or tended to induce, a shifting of attention away from the driving task. For example, a pretty girl might tend to induce a driver to shift his attention; a sudden event outside the car, such as an explosion or screech of tires, might *compel* such a shift of attention.

Other examples of external distractions include the actions of other traffic; driver-selected outside activity such as looking for street signs, looking for house numbers, and examining particular pieces of property; activities of special interest, such as a fight, person in bikini, accident, or fire; or other sudden events such as loud noises, explosions, flashes of light, sudden screech of tires.

External distraction is to be distinguished from *inattention (preoccupation),* in which the driver shifts his attention from the driving task, but is not compelled or induced to by any event, activity, or object. External distraction is especially to be distinguished from *improper lookout,* over which it takes precedence; in other words, if a driver fails to maintain an adequate or proper lookout because of an external distraction, only the external distraction category will apply.

(d) Inadequate or improper lookout

This category applies whenever a driver is delayed in his recognition of information needed to safely accomplish the driving task, because he encountered a situation requiring a distinct visual surveillance activity (for safe completion of the driving task), but either did not look or did look, but did so inadequately. Thus, included are both cases where a driver "looks but does not see," and the cases where a driver needed to look but did not even attempt to, as for example in pulling out to pass without first checking for traffic in the passing lane.

The improper lookout category frequently applies in situations where a driver is pulling out from a parking place; entering the travel lane from an intersecting street, alley, or driveway; or prior to changing lanes or passing.

Inadequate or improper lookout is to be distinguished from the *inattention, internal distraction,* and *external distraction* categories; these three categories all take precedence when they are *known* to apply. The distinction between this category and inattention may be particularly difficult, and hence this rule of thumb will ordinarily apply: if the driver has shifted his attention from the driving task so that he does not recognize that he has encountered the driving situation which gave rise to the need to look, inattention shall apply; otherwise, the inadequate or improper lookout category is appropriate. In using this rule, note that for inadequate or improper lookout to apply it is not necessary that the driver recognize the need to look; it is only necessary that he be aware that he has encountered the situation which gave rise to the need (e.g., knew that he was entering an intersection, or that he was overtaking another vehicle).

Note also that when a driver entering or crossing a one-way street fails to check for wrong-way traffic, this is classified as an *inadequately defensive driving technique,* rather than as an *inadequate or improper lookout.*

3. Delays in recognition for other or unknown reasons

   This includes all *delays in recognition* (as previously defined), which though known to have occurred, cannot be explained in detail. Thus, the fact of a delay in perception or comprehension of needed information is established in these cases, but a precise reason for these delays cannot be established.

D. Decision errors

This refers to all situations where a driver is involved in an accident, or experiences an unnecessarily severe impact, because having received information indicating the need for a change in speed or path of travel, he chooses an improper course of action, or takes no action.

To a large extent, this top-level category is defined by the next-level (more specific) categories included under it. These are *misjudgment, false assumption, improper maneuver, improper driving technique or practice, inadequately defensive driving technique, excessive speed, tailgating, inadequate signal, failure to turn on headlights, excessive acceleration, pedestrian ran into traffic,* and *improper evasive action.*

1. Misjudgment

   This category applies whenever a driver miscalculates the separation in time and space, or the closure rate, of his own vehicle with respect to other objects, and then acts to his detriment on the basis of this improper evaluation.

2. False assumption

   This category applies whenever a driver takes action, or fails to take action, based on a decision or opinion arrived at by assuming that to be true which in fact is not true. For example, if a driver pulls out in front of another driver who is signaling a turn, assuming that the other driver will turn before reaching his location, when in fact that driver has no intention of turning until he is past that location, the original driver's mistake is properly classified as a *false assumption.* In this instance, the *false assumption* category is to be distinguished from *inadequately defensive driving technique,* over which it takes precedence when the fact of a false assumption has been clearly established.

   Additional examples of *false assumption* include assumptions that other drivers must stop or yield at intersections, when in fact they do not; that a vehicle is going to make a turning maneuver which it does not, and assuming that no traffic is coming when in fact there was traffic coming (as in the "good-Samaritan" situation).

3. Improper maneuver

   This category applies whenever a driver willfully chooses a vehicle path which is wrong, in the sense of being obviously calculated to generate an exceedingly high *risk* of collision. Examples include turns from the wrong lane, proceeding straight in a turn lane, driving the wrong-way on a one-way street, or passing at an improper location, such as an intersection.

   In Phase I results only, *improper driving techniques* and practices were included under *improper maneuvers.*

   Improper driving techniques and practices are subsequently defined, and were separately categorized in Phase II.

4. Improper driving technique or practices

   This category applies when a driver engages in the improper control of path or speed, in a manner which unduly increases the risk of accident-involvement, ***and*** involves practices which are (or might be) habitual to a particular driver (the risk involved not being fully appreciated). Examples include cresting hills while driving in the center of the road, and stopping too far out into roads or intersections as a matter of choice.

   This category is to be distinguished especially from *improper maneuver,* due to the similarity of these categories. In some cases, the distinction between these categories is difficult, being one of degree rather than kind. The key distinction is that of driver recognition of risk, and hence likelihood of habitual reoccurrence; it is unlikely that a driver would habitually repeat what he realized to be an unnecessarily risky practice. Hence, for example, a turn from the middle lane of a one-way three-lane street would be classified as an *improper maneuver;* it is not likely that a driver will engage in this maneuver if he recognizes that traffic could be approaching from behind in the lanes that he crossed. However, for years a driver might crest hills on country roads driving in the center, or stop too rapidly to make turns, without accident involvement, and without realization of the risks involved. Such cases are categorized as *improper driving techniques or practices.*

5. Inadequately defensive driving technique

   This category applies whenever a driver unnecessarily places his vehicle in a position where there is a foreseeable and substantial risk of collision *if* another driver performs contrary to normal expectations, or places his vehicle in such a position without adequately checking to ensure that another driver is not engaged in such an unexpected action. Examples include entering an intersection on reliance that an on-coming vehicle will stop for its traffic signal, despite the fact that it has given no indication of slowing to do so. Another example would be crossing or entering a one-way street without looking for wrong-way traffic.

This category is to be distinguished from categories which are used when drivers place their vehicles in positions (or do so without adequately checking first) where they become subject to risks in the normal course and flow of traffic. The key distinction is that in this case, the risk is generated by the *improper* and *ordinarily unexpected action* of other traffic units.

6. Excessive speed

   This category applies when a driver excessively increases the risk of accident involvement, by choosing to travel at too great a speed. The judgment that a vehicle's speed is excessive is necessarily a highly subjective one; an *excessive speed* is one greater than a person driving to a high, but reasonable standard of good defensive driving practice, would choose to travel under existing conditions.

   It should be noted that the evaluation that speed is excessive is specifically not to be determined with reference to the prevailing speed limit. Prevailing speed limits are to be considered, but primarily in the context of determining the reasonable expectations of other drivers as to the speed of traffic likely to be encountered.

   Excessive speed in this context may be excessive for the road design, regardless of its condition or prevailing traffic conditions; in light of traffic, pedestrians, or number of accesses; in light of prevailing weather conditions, or in light of combinations of these factors.

7. Tailgating

   This category applies when a driver follows another vehicle so closely that, even if he is attentive to the actions of the vehicle being followed (the the extent which can ordinarily be expected from a driver over an extended period of time), should the vehicle being followed suddenly engage in maximum braking, collision ordinarily could not be avoided.

8. Inadequate signal

   This category applies whenever a signal would ordinarily be expected from a person driving at a standard of good defensive driving practice, *and* it is determined that had such a signal been given, it would have been received and acted on by other persons (drivers, pedestrians, etc.), so that the accident would have been prevented or its severity reduced. Included are all types of signals which communicate information between traffic units, including turn signals, indications of braking or slowing, or warning or alerting signals given by the honking of a horn.

9. Failure to turn on head lamps

   This category applies whenever a driver fails to turn on his headlights despite the fact that the sky has sufficiently darkened to substantially hinder his ability to see or be seen, and this fact is in turn related to the accident occurrence or severity.

10. Excessive acceleration

    This category refers to a situation where a driver accelerates so rapidly that his ability to maintain directional control is hindered to the point that control is lost. This category is to be distinguished from excessive speed; it refers specifically to the situation where wheelspin or similar phenomena associated with rapid acceleration induce directional instability.

11. Pedestrian ran into traffic

    This category applies whenever a pedestrian moves into a traffic lane at such a place and in such a manner, as to create a high risk of contact from even lawfully and prudently driven vehicles. These thus represent cases where the pedestrian is culpable, without regard to whether a striking driver was at all blameworthy. Typically, such accidents have involved people running out into traffic, often without looking at all; many such pedestrians have been children.

12. Improper evasive action

    This category refers to a situation where an alert driver, driving to a high but reasonable standard of good defensive driving practice, could by braking, steering, accelerating, or by engaging in combinations of these actions, have either avoided collision entirely, or have significantly reduced the severity of the impact which resulted. This category does *not* apply merely because it is determined by investigation that there was an evasive action which *could* have been taken successfully; it must also be an evasive action which was *apparent* (or should have been apparent) to the driver on the basis of information available to him, and which was *reasonable*, based on that information. It might not be reasonable, for example, to swerve into an opposing traffic lane and risk a head-on collision, even though it might later be determined by investigation that in fact no such collision would have occurred, and hence the accident could have been avoided by taking that chance.

An especially notable example of *improper evasive action* is the situation where a driver locks his brakes and is therefore unable to initiate an evasive steering action to avoid a car stopped ahead, where had the brakes not been locked it could easily have been accomplished.

E. Performance (action) errors

This category refers to situations where a driver properly perceives and comprehends information indicating the need for an adjustment in speed or path of travel, but commits driving errors which involve either impulsive improper actions (as in panic or freezing), or lack of adequate *skills* (as in over-compensation). These are to be distinguished from errors involving an improper choice of action from among available alternatives, which are termed *decision errors.*

To a large extent, this category grouping is defined by the next-level (more specific) categories which comprise it; these are *over-compensation, panic or freezing,* and *inadequate directional control.*

1. Overcompensation

This refers to situations where a driver improperly reacts to a situation impairing the maintenance of control over the vehicle. Such overcompensations include improper or excessive acceleration, braking, and/or steering inputs. This category is most typically applied when a driver allows his vehicle to deviate from its intended path, as in the case where he allows the right-side tires to drop off the pavement edge, and then looses control by attempting to regain the intended path in too abrupt a manner.

2. Panic or freezing

This refers to the situation where a driver perceives the risk of collision, and as a result is unable or does not have the presence of mind to take any significant remedial action. He is either unable to estimate what remedial action is required, or realizing it, is unable to initiate the muscle responses necessary to cause that action to be taken.

This category also refers to situations where, in recognition of risk of collision or loss of control, a driver takes an impulsive, irrational action, which is obviously not calculated to reduce the risk. For example, preceding collision, such a driver might remove his hands from the wheel and throw them up in front of his face, in a situation where had he not panicked a reasonable evasive action would have been possible.

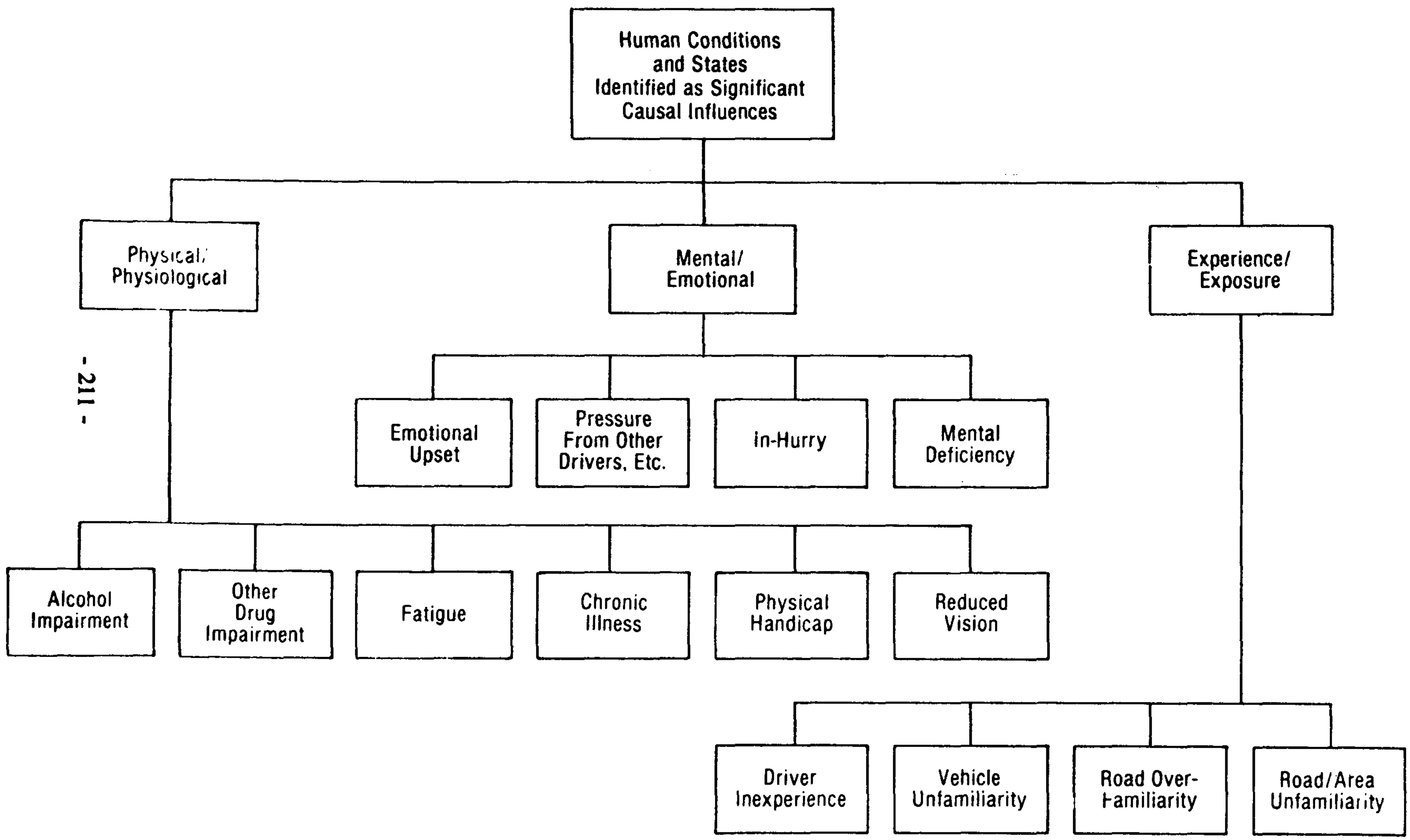
3. Inadequate directional control

   This category refers to situations where a conscious driver does not maintain adequate control over the path of his vehicle, although such control would have easily been possible had appropriate steering inputs been applied. This does not apply to the situation where high lateral loads make continued control a delicate matter, and overtax the skills of the driver. Rather, these are situations where adequate lateral traction is available, so that had the driver adequately monitored information regarding the need for steering inputs, and then applied these inputs with skill reasonably expected from an ordinary driver, control could easily have been maintained.

   Frequently, this category is applied when a conscious driver fails to maintain directional control in a relatively untrying situation, and information is not available to allow a more precise category to be applied. For example, where there is information that the driver was *distracted* or was *preoccupied,* and hence did not notice the deviation of his vehicle from the intended path in sufficient time, those specific categories would apply. However, where such information cannot be obtained, but it is known that the driver was conscious and should have easily been able to complete the necessary steering task, the *inadequate directional control* category applies.

Glossary Figure 3

Causal Factor Tree for Human Conditions and States



Outline

II. Human Conditions and States

A. Physical/physiological

1. Alcohol impairment
2. Other drug impairment
3. Fatigue
4. Physical handicap
5. Reduced vision
6. Chronic illness

B. Mental/emotional

1. Emotionally upset
2. Pressure or strain
3. In-hurry
4. Mental deficiency

C. Experience/exposure

1. Driver inexperience
2. Vehicle unfamiliarity
3. Road over-familiarity
4. Road/area unfamiliarity

Definitions

II. Human Conditions and States

These are factors which adversely affect the ability of the driver to perform the information processing functions necessary to safe performance of the driving task. As such, these conditions and states may result in information processing errors which, in turn, are the direct causes of traffic accidents. In a sense, these are "causes of accident causes." Due to the remoteness of their involvement, such factors are difficult to implicate with certainty through the clinical examination of individual accidents. Nevertheless, in some cases unusual evidence does enable a causal relationship to be established, and the causal involvement of such factors has been tabulated according to the same assessment system as was utilized for human direct causes.

A. Physical/physiological

1. Alcohol impairment

Alcohol impairment may be cited as a causative condition or state whenever it is concluded that consumption of alcohol has occurred which may account for a driving error which has played a causal role in an accident. As such, this factor may be cited both where a driver is clearly intoxicated, and where he has been drinking but has not reached a state of intoxication.

Intoxication is the intake of alcoholic beverages to the point of obvious physical impairment. Determination of the legal blood-alcohol definition of intoxication is of minor concern (and often not available), although a BAC in excess of .10% should be considered indicative of intoxication. What is more important is the degree of involvement of the intoxicated driver in the accident. If he was stopped legally at a stop sign or signal and is hit in the rear then his intoxication probably had nothing to do with the cause of the accident and should be given less consideration. If his involvement includes misjudgment, speeding, delayed reaction, illegal maneuvers, etc., then alcohol impairment should be considered as at least a possible causal factor.

The weight, or degree of assurance, that intoxication was a (1) possible cause, (2) probable cause, or (3) definite cause depends mainly upon the degree of involvement and driver error in the accident. In this case actions such as walking, talking, pupil dilation, eye focusing, breath odor, etc., serve as strong clues as to the extent of intoxication.

Drinking is the admission or detection by the investigator that the driver had a few alcoholic drinks. The major difference between drinking and intoxication is the physical appearance of the driver. Many times the driver will not appear intoxicated although admitting to "having a couple of drinks," or there is a faint smell of alcohol on his breath. The term drinking may not refer exclusively to physical impairment but may imply a psychological change. Drinking may have reduced mental alertness and driver attitude.

In many cases the drinking driver may appear to be physically capable of driving but be in a belligerent mood which the investigator may suspect to be induced by the alcohol (CAL).

2. Other drug impairment

This is the intake by a driver of some drug (other than alcohol) which could physically affect reaction. This refers to a driver who had admitted taking tranquilizers, benzedrene, strong cold tablets, pain killers, sleeping pills, amphetamine, etc. within a 12 hour period before the accident occurrence. The effects on driving behavior and reaction time might be observed in the form of slow movements, incoherence, glassy eyes and an intoxicated appearance. Drivers who appear intoxicated (by their actions) with no evidence or admission of drinking alcoholic beverages should be questioned about the use of drugs. The 12 hour time period may appear high but is realistic in the case of strong drugs. In the case of cold tablets and milder drugs, a 4-6 hour time period may be more appropriate (CAL).

3. Fatigue

   Fatigue is a condition of mental or physical exhaustion, or both, which is induced by an inordinate level of, or a prolonged period of, activity. In general, fatigue results in a decrease in a driver's ability to respond to stimulation. Less than a normal night's sleep, a long day on the job, a new work-shift, three to five hours of continuous driving, a recent illness, or a full day of recreational activity are examples of the conditions that might cause a driver to be fatigued.

   Observations of the driver which would indicate fatigue include droopy eyelids, slow movements, hesitant responses to questions or slight incoherence, bloodshot eyes, yawning, and an overall pale, exhausted look.

4. Physical handicap

   Such handicaps might be either temporary or permanent. It includes a temporary condition which physically limits the driver in performing normal driving functions—and is especially critical in those maneuvers requiring extra effort from the driver. Examples are (1) broken limbs, (2) some injury which a cast or extreme amount of tape is covering, (3) a recent operation leaving the driver uncomfortable, or (4) pregnancy.

   Examples of permanent handicaps to a driver which may affect his driving ability would be, an amputation or permanent defect to an arm or leg, a crippling disease, etc.

   Handicapped drivers who have no use of their legs generally have special hand controls on their vehicles and all vehicle control (acceleration, braking and steering) is accomplished with the hands (CAL).

5. Reduced vision

   This factor refers to both temporary and permanent impairment. Temporary vision impairment is a condition of reduction in a driver's normal vision due to some temporary eye defect or hindrance. Visual acuity is generally affected. It may be the consequence of a foreign particle ledged in an eye, a stye, eye strain from driving into bright sunlight, or wearing required corrective lenses, or wearing sunglasses on an overcast day or at night, for examples.

Permanent vision impairment is a condition of permanent reduction or defect in a driver's vision. A damaged or missing eye, color blindness, cataracts, or extremely poor vision (e.g., 20/150 or poorer) are a few examples of this condition. Permanent eye defects inhibit the driver's ability to adequately monitor the driving situation and thus expose him to an increased risk of collision.

6. Chronic illness

A chronic illness is a long-lasting, recurrent illness which detracts from driver efficiency. Long term or chronic illnesses not only affect the driver's comfort and state of mind, but also may affect his driving ability. Illnesses such as arthritis, asthma, hay fever and rheumatism can diminish driver ability to maneuver and driver comfort during the driving task.

Indications of chronic illness include delayed or slowed reactions and complaint that an illness was bothering the driver (CAL).

B. Mental/emotional

1. Emotional upset

Emotional upset is an acute affective disturbance (positive or negative) arising from the psychological situation and expressing itself in conscious experience, behavior, and physiological processes. The dynamic determinants of emotion include conflict, frustration, thwarted (or satisfied) expectation, tension (or its release), painful stimulation, threat, insult, and similar conditions of stress or relief. The emotionally upset driver functions at a reduced level of efficiency due to the impairment of his normal rational, intellectual, and mental capabilities and hence becomes more vulnerable to dangerous situations and less perceptive of external cues. Consequently his driving may include an angry or careless maneuver, hesitant or unsure decision, and a delayed reaction.

The most prominent emotional states which may cause these effects are:

- anger (i.e., fight with spouse; just got cut off by another vehicle; traffic moving too slowly)

- confusion (i.e., lost—insufficient information; wrong maneuver—information overload)
- depression (i.e., just lost job; family problems; recently divorced)

2. Pressure or strain

Pressure or strain is a condition of excessive demands for action exerted on a driver that produces disturbances of the psychological or physiological systems, or both. Typically the source of pressure or strain is the "other driver" who instigates the driver to take action immediately without careful consideration of the driving situation. Thus the driver reacts to the pressure rather than acting rationally in terms of the driving situation. A driver stopped at a red light with no intention of turning may be pressured to turn without carefully checking for cross traffic by another driver intent on turning right on red, for example.

3. In-hurry

A driver is in a hurry when he feels compelled to extend himself to or beyond the safe limits of the driving system due to a heightened sense of urgency. This compelling sense of urgency may depend all or in part on the driver's subjective judgment (feeling) about the adequacy of available time, regardless of the objective time parameters of the situation.

In addition to generally taking more chances, the hurried driver might: speed, tailgate, run a stop sign or red light, "stretch out" an amber light, change lanes carelessly, cut corners, etc.

4. Mental deficiency

Mental deficiency refers to a mentally disturbed driver or one whose intelligence is far below normal. If obvious deficient behavior is observed during the interview with the driver, or if he has been known to have been in a mental institution, or has had several nervous breakdowns, this deficiency must be taken into consideration. The behavior of such drivers in emergency situations may be critically delayed or improper (CAL).

C. Experience/exposure

1. Driver inexperience

Driver inexperience refers to a lack of adequate exposure to the overall driving task. Common occurrences induced by driving inexperience include inability to control the vehicle, distance-velocity misjudgments, improper evasive actions, and panic maneuvers. Empirically, drivers with less than 2 years experience or drivers who drive less than 5,000 miles per year fall into this category. Also, truck or bus drivers with limited experience in that type of vehicle could also be termed "inexperienced," as could drivers who have not driven for a long period of time (i.e., military service). However, if inexperience had nothing to do with the accident situation, it obviouly should not be considered as a factor (CAL).

2. Vehicle unfamiliarity

   Vehicle unfamiliarity refers to a lack of driving time in a particular vehicle. Borrowed, rented, or owned vehicles driven for less than 6 months are considered unfamiliar to the driver. Characteristics such as different locations of controls and accessories, different transmissions, different sized vehicles, different power outputs, etc. could all contribute to an accident situation. If the handling aspects of the involved vehicle generated responses different than anticipated during the accident sequence then vehicle unfamiliarity should be considered as a potential factor (CAL).

3. Road over-familiarity

   Over-familiarity is overexposure to a driving routine which can introduce complacency, contempt, etc. Just as unfamiliarity with the road could be a contributing factor to driver confusion or inattention in an accident event, at the other extreme, the driver who has driven the accident route a large number of times (i.e., back and forth to work for 2-3 years or several times daily as a delivery route) so that the trip has become routine, may become over-familiar with the route. He has become accustomed to signal timings, traffic density, road configuration, etc. to the point of possible complacency. Any unexpected events may not be perceived or recognized immediately due to a certain monotony and inalertness to the driving task. This complacent behavior with a normally routine environment may induce a delay in reactions to unexpected events (CAL).

4. Road/area unfamiliarity

   Road unfamiliarity is lack of driving exposure to a particular road. Drivers who seldom drive on a particular road are at a disadvantage because of their lack of knowledge of the configuration, speed limit, signals, signs, intersections, turns, etc.

   Indications of road unfamiliarity include: seeking street names or house numbers; excessive speed on a curve; confusion with the signal system; falsely assuming other traffic controlled by stop signs at intersections; etc. (CAL).

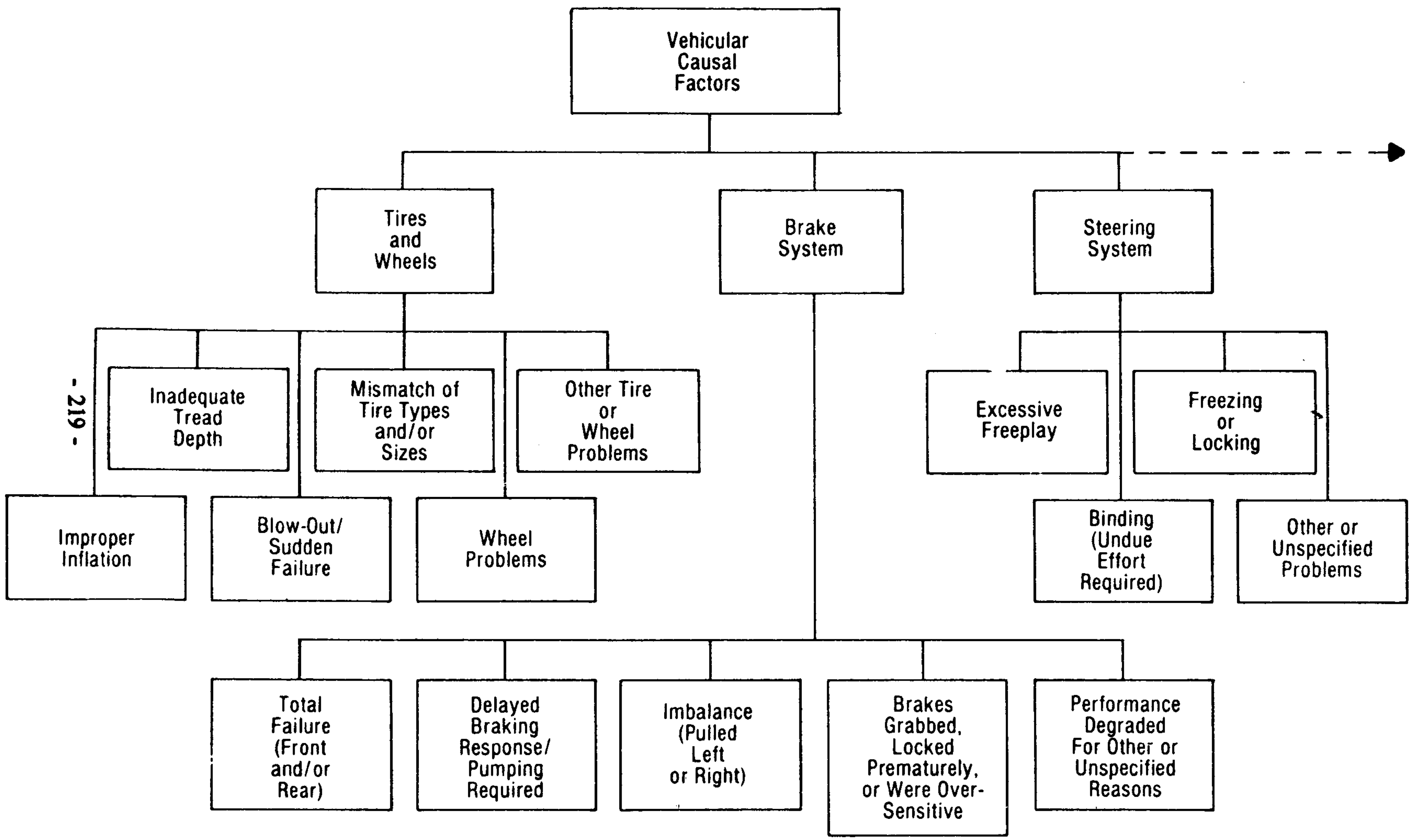
Area unfamiliarity is lack of exposure to the road, traffic and traffic control system of a particular area. Unfamiliarity with the area in which the accident occurred may have had some of the following effects on the driver:

- traffic density and speed for prevailing conditions are unknown and confusing
- traffic regulations, placement of signs, signals, etc. may be unfamiliar
- driver may be distracted by reading road signs and following directions
- drivers when lost often become confused, angry, upset, etc. thus reducing their attentiveness

Drivers from other geographic areas (especially from other states) and those who have been in the area only once or twice qualify for this factor. Inattentiveness and hesitative driving behavior are strong clues that the driver was unfamiliar with the area (CAL).

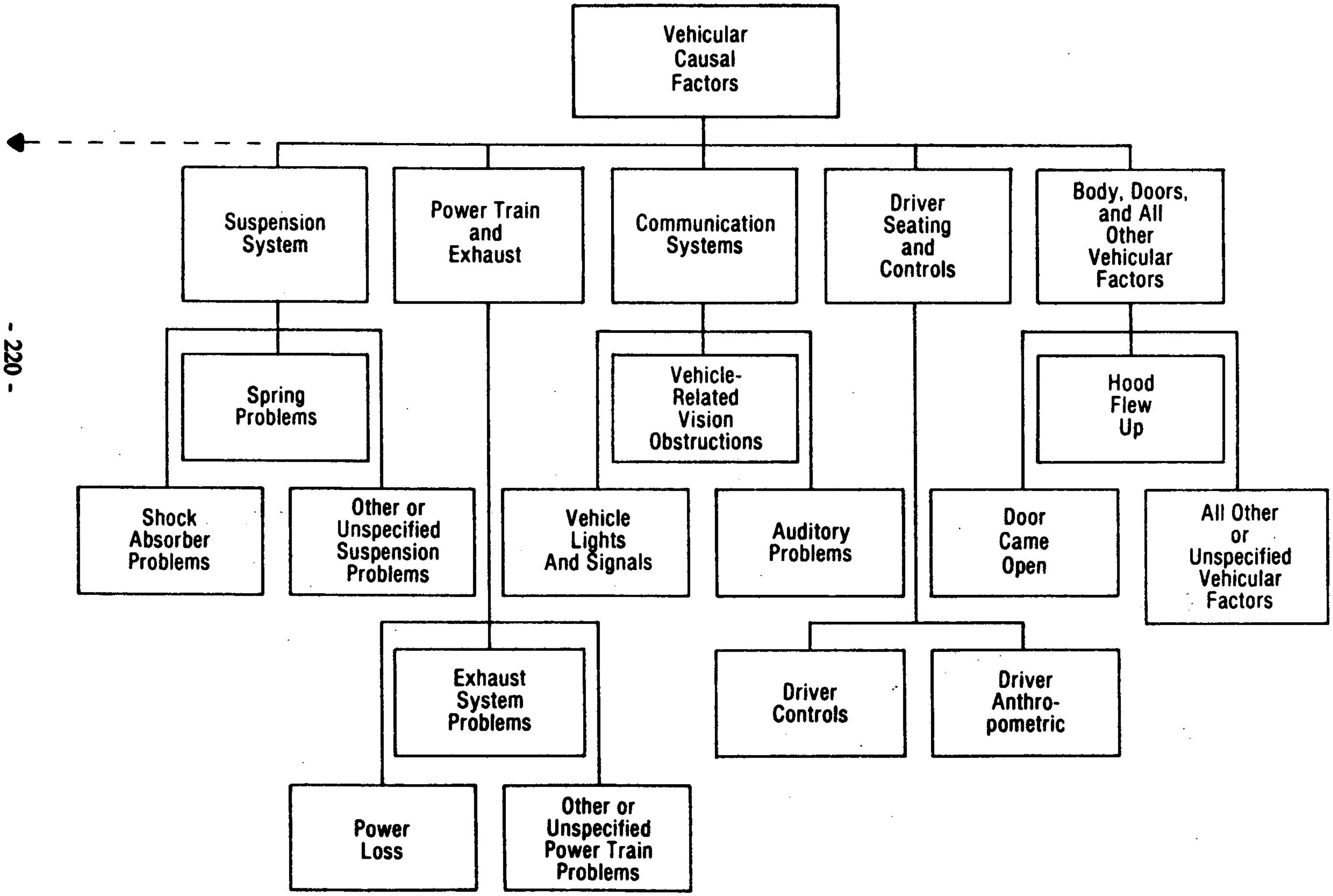
Glossary Figure 4

Causal Factor Tree for Vehicular Causal Factors



Glossary Figure 4 (continued)

Causal Factor Tree For Vehicular Causal Factors



Outline

III. Vehicular Causal Factors

A. Tires and wheels

1. Inflation

   (a) Under-inflation
   (b) Over-inflation
   (c) Improper pressure distribution

2. Inadequate tread depth
3. Blow-out/sudden failure
4. Mismatch of tire types and/or sizes
5. Wheel problems (failures, etc.)
6. Other tire or wheel problems

B. Brake system

1. Total failure (front *and/or* rear)

   (a) Total failure—front *and* rear

      (1) Wheel cylinder failed
      (2) Brake line failed
      (3) Master cylinder defect
      (4) Insufficient fluid level
      (5) Adjustment mechanism loss or failure
      (6) Other or unspecified reasons

   (b) Failure-related front only

      (1) Wheel cylinder failed
      (2) Brake line failed
      (3) Master cylinder defect
      (4) Insufficient fluid level
      (5) Adjustment mechanism loss or failure
      (6) Other or unspecified reasons

   (c) Failure-related rear only

      (1) Wheel cylinder failed
      (2) Brake line failed
      (3) Master cylinder defect

(4) Insufficient fluid level
(5) Adjustment mechanism loss or failure
(6) Other or unspecified reasons

(d) Total failure—unknown or unspecified as to portion affected

(1) Wheel cylinder failed
(2) Brake line failed
(3) Master cylinder defect
(4) Insufficient fluid level
(5) Adjustment mechanism loss or failure
(6) Other or unspecified reasons

2. Delayed braking response/pumping required

(a) Required pumping due to improper adjustment
(b) Other or unspecified reasons

3. Imbalance (pulled left or right)

4. Brakes grabbed, locked prematurely, or were over-sensitive

(a) Improper proportioning front-to-rear (e.g., rear wheel lock-up)
(b) Brakes, "grabbed," locked prematurely, or were over-sensitive, etc.

5. Performance Degraded for other or unspecified reasons

C. Steering system

1. Excessive freeplay
2. Binding (undue effort required)
3. Freezing or locking
4. Other or unspecified problems

D. Suspension problems

1. Shock absorber problems

(a) Weak shock absorbers
(b) Missing, broken, or other shock absorber problems

2. Spring problems

(a) Broken, missing, or defective springs
(b) Raised rear-end
(c) Spring imbalances (due to helper springs, overload springs, spring spacers, etc.)

3. Other or unspecified suspension problems

E. Power train and exhaust

1. Power loss

(a) Ran out of fuel
(b) Other or unspecified problems

2. Exhaust system

(a) CO leaked into driver's compartment
(b) Other or unspecified problems

3. Other or unspecified power train problems

F. Communication systems

1. Vehicle lights and signals

(a) Headlamp problems

(1) Inoperable headlamps
(2) Mis-aimed headlamps
(3) Dirt-obscured headlamps

(b) Inoperable taillights
(c) Inoperable turn signals
(d) Taillights or turn signals obscured by dirt, road grime, etc.
(e) Other light problems

2. Vehicle-related vision obstruction

(a) Due to ice, snow, frost, water, or condensation on windows
(b) Due to cracked or opaque windows (e.g., cardboard or stickers on windows)
(c) Due to design or placement of windows
(d) Due to objects in or attached to vehicle
(e) Due to inoperative or deficient vision hardware

(1) Inoperable or mis-aimed windshield washer
(2) Inoperable or ineffective wiper
(3) Inoperable or inadequate defroster
(4) Absence or condition of mirrors

(f) Other

3. Auditory problems

   (a) Inoperable or weak horn
   (b) Excessive radio or tape player volume inside car
   (c) Other or unspecified problems

G. Driver seating and controls

1. Driver controls

   (a) Steering wheel problem; (e.g., spinner snagged clothing)
   (b) Brake pedal problem; (e.g., pedal broke off)
   (c) Accelerator problem; (e.g., stuck)
   (d) Other or unspecified problem

2. Driver anthropometric

   (a) Seat loose or became detached
   (b) Driver not positioned to adequately reach controls
   (c) Driver not positioned to see adequately
   (d) Other or unspecified problems

H. Body, doors, and all other vehicular factors

1. Door came open
2. Hood flew up
3. All other or unspecified vehicular factors

Definitions

This refers to all vehicle-related deficiencies which result in an accident, or increase the severity of vehicle impact which results. Included are system failures, degradations, and worn components. For the most part, deficiencies were assessed based on comparison to OEM standards, which were used in establishing the pass-fail criteria for the inspection of accident vehicles (see: vehicle inspection forms and procedures and pass-fail criteria in *Interim Report of a Study to Determine the Relationship Between Vehicle Defects and Crashes: Methodology*).

A. Tires and wheels

This includes all causal failures and improper conditions associated with *tires and* *wheels,* as determined by the established pass-fail criteria. Included are inadequate tread depths, blow-outs, mismatches of tire types and/or sizes, improper inflation, and wheel failures.

B. Brake system

This includes all accidents resulting from the failure, or degraded or abnormal performance, of the braking system. This includes both gross failure of all or part of the braking system, delayed braking (as where pumping is required), brake imbalances (as where hard application causes a marked change in vehicle path), etc.

C. Steering system

This includes all failures or degradations of the steering system whereby accurate steering control is negated or made grossly more difficult than ordinarily expected. Examples include excessive freeplay and freezing or locking of the steering gear.

D. Suspension problems

Suspension problems include failures or degradations of shock absorbers, springs, bushings, locating links and arms, etc., which hinder vehicle control.

E. Power train and exhaust

This includes any failure or substandard performance of the engine, drive train, or exhaust system that causes an accident, such as a sudden loss of power or the leakage of exhaust fumes into the driver compartment, with a consequent detrimental effect on driver behavior. Power loss as a result of running out of fuel is included.

F. Communication system

This includes all failures and degradations of systems by and through which drivers send and receive the visual and auditory information necessary for safe completion of the driving task. These systems thus include lights, glazed surfaces, horns, and windshield wipers and washers.

G. Driver seating and controls

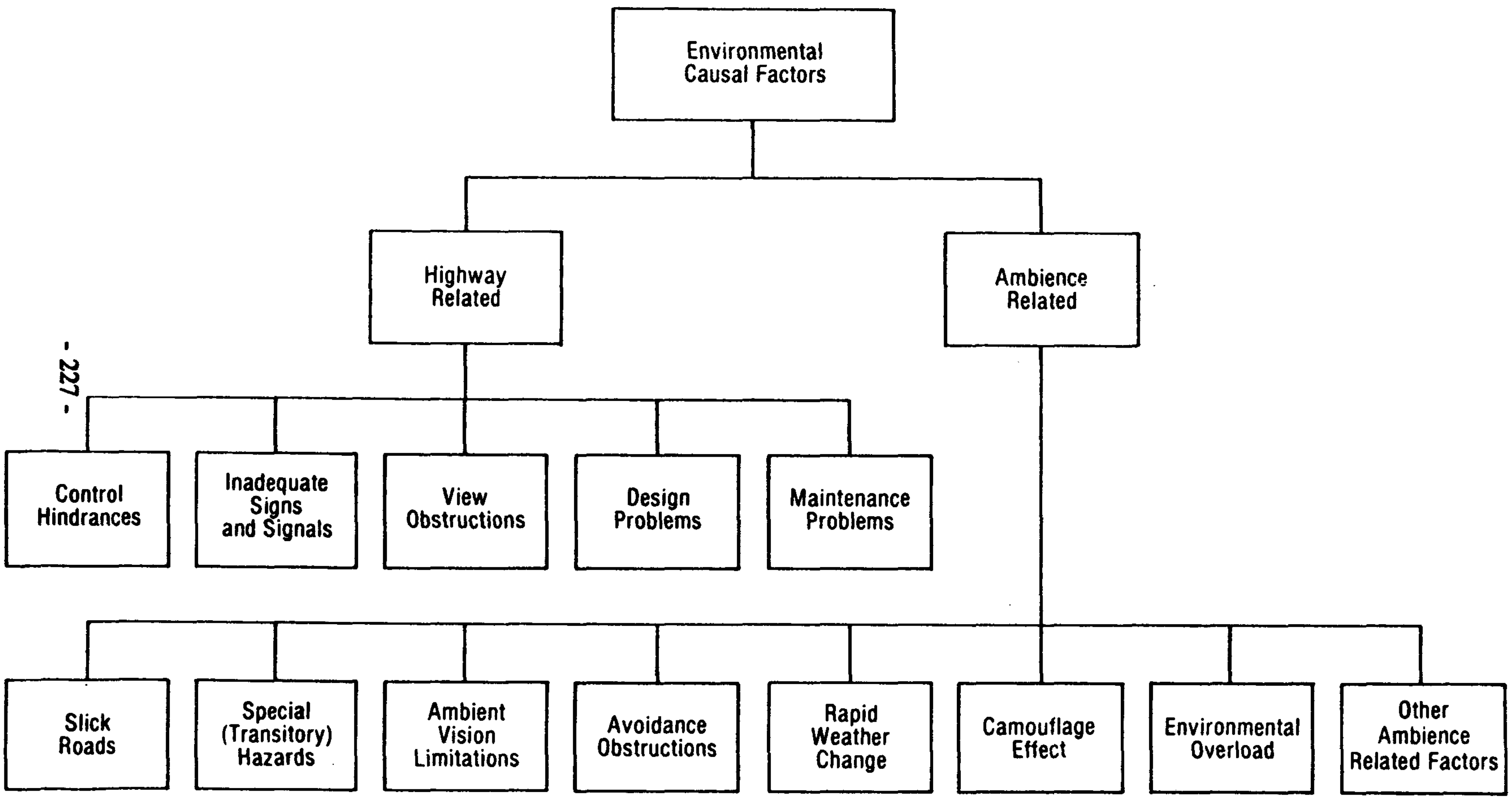
This includes all instances where driver seat location failures and deficiencies impair the driver's ability to safely complete the driving task, as by limiting his ability to see and/or manipulate controls, as well as where difficulty is experienced with driver controls, such as when an accelerator pedal sticks.

H. Body, doors, and all other vehicular factors

This category includes all failures in the integrity of body and doors, which act to impede vehicle control, and hence are pre-crash accident-causative factors. In addition, all vehicular factors not categorized elsewhere were placed under this heading. Examples are doors which come open while rounding curves, causing drivers to lose control, and hoods which fly up, thereby blocking vision, with the same result.

Glossary Figure 5

Causal Factor Tree for Environmental Causal Factors



Outline

IV. Environmental Causal Factors

A. Highway related

1. Control hindrances
   - (a) Drop-offs at pavement edge
   - (b) Excessive road crowns
   - (c) Improperly banked curves
   - (d) Soft shoulders
   - (e) Ditches, embankments, and other road side features
   - (f) Unexpected wet or slick spots
   - (g) Other or unspecified control hindrances
2. Inadequate signs and signals
   - (a) Stop sign needed but not provided
   - (b) Stop sign present but not adequate
   - (c) Curve warning signs needed
   - (d) Curve sign present but not adequate
   - (e) Signal light poorly placed and/or not adequately visible
   - (f) Poor signal timing
   - (g) Center or lane lines not present or inadequate
   - (h) Edge lines not present or inadequate
   - (i) Other or unspecified
3. View obstructions
   - (a) Hillcrests, dips, etc. (road surface features)
   - (b) Roadside embankments, escarpments, etc.
   - (c) Roadside structures and growth
   - (d) Stopped traffic
   - (e) Parked traffic
   - (f) Other or unspecified view obstructions
4. Design problems
   - (a) Accesses not sufficiently limited or improperly placed
   - (b) Intersection design problems
   - (c) Road overly narrow, twisting, etc.
   - (d) Trees and other fixed objects too close to road presenting excessive collision hazard

(e) Other or unspecified design problems

5. Maintenance problems

   (a) Signals inoperative
   (b) Traffic control sign missing
   (c) Traffic control sign or signal obscured
   (d) Other or unspecified problems

B. Ambience-related

1. Slick roads

   (a) Road wet
   (b) Road snow and/or ice covered
   (c) Gravel and/or sand on paved surface
   (d) Road slick due to traffic polishing
   (e) Wet and traffic polished asphalt
   (f) Gravel road
   (g) Other or unspecified problems

2. Special (transitory) hazards

   (a) Animal in road
   (b) Object in road
   (c) Non-contact vehicle caused problem
   (d) Stopped vehicle in road
   (e) Other

3. Ambient vision limitations

   (a) Rain
   (b) Snow
   (c) Fog
   (d) Darkness
   (e) Glare from sun
   (f) Glare from headlights
   (g) Other

4. Avoidance obstructions

   (a) Parked or stopped traffic
   (b) Trees and other fixed objects
   (c) Other or unspecified

5. Rapid weather change
   (a) Suddenly-encountered fog
   (b) Suddenly-encountered slick roads
   (c) Other or unspecified
6. Camouflage effect
   (a) Motor vehicle blended in with background
   (b) Other or unspecified
7. Environmental overload
8. Other ambience-related factors

Definitions

IV. Environmental Causal Factors

Environmental factors are those factors external to the driver or vehicle which increase the risk of accident involvement unnecessarily or to an excessive extent. Such factors are categorized as being either *ambience-or highway-related.* For the most part, an ideal norm is assumed, based on ideal ambient conditions (including dry roads and good visibility), and published design and control standards in common usage.

A. Highway-related environmental factors

These are generally factors of a relatively permanent nature, and are those closely associated with highway design, construction, and/or maintenance.

To a large extent this category is defined by the next-level (more specific) categories which it includes. These are *control hindrances, inadequate signs and signals, view obstructions, design problems,* and *maintenance problems.*

1. Control hindrances

This category refers to road surface configurations which tend to excessively disturb directional stability. Examples of such factors include drop-offs at pavement edges, soft shoulders, and unforseeable wet or slick spots.

2. Inadequate signs and signals

This category refers to all situations where due to lack of adequate information, or modification of traffic flow, the risk of accident involvement is increased so greatly that even an alert and prudent driver might be caused to be involved in an accident.

3. View obstructions

This category refers to situations where environmental factors prevent or limit the receipt of visual information needed for safe completion of the driving task, and thereby significantly increases the risk of accident involvement. Factors considered to be view obstructions include hillcrests and dips in road surfaces, roadside structures and growth, and stopped or parked traffic. For consistency both permanent and transitory obstructions are included in this category.

4. Design problems

This category designates roadway and intersection designs configurations which deviate from some reasonable ideal, such as standards recommended by AASHO or DOT, and by doing so significantly increase the risk of accident involvement. Examples in the study area include major shopping center accesses located in close proximity to high volume intersections, and country roads which are unexpectedly narrow. In each case, these are situations which are felt to create significantly increased risks of involvement, so that even an alert and prudent driver might occasionally be expected to fail to safely complete the driving task.

5. Maintenance problems

This category refers to environmental situations which significantly increase the risk of accident involvement, arising out of the need for roadways and/or signs to be restored to their intended status. Examples of factors falling in this category include inoperative signals and missing or obstructed traffic control signs or signals. *Maintenance problems* is to be distinguished from *control hindrance,* in that *control hindrance* takes precedence when it is known to apply.

B. Ambience-related environmental factors

This category primarily refers to transient environmental factors, such as those associated with weather and with transient traffic situations.

1. Slick roads

This category applies whenever it is determined that an accident has occurred which would have not occurred had the road surface present been dry, clean, paved, non-travel polished, and in otherwise good repair.

2. Special hazards (or transients hazards)

This category refers to transient hazards which increase the risk of an accident. Included are animals and objects in the road, and non-contact vehicles and drivers which cause problems. Examples of the latter kind include vehicles which force accident-involved vehicles off the road, and then continue without involvement. Since it cannot be determined what the nature of the human, vehicular, or environmental causes are which caused the errant behavior of the non-contact vehicle, it is desirable to view the actions of such a non-contact vehicle as transient environmental hazards for the involved driver who is the subject of investigation; consistency can only be achieved in this manner.

3. Ambient vision limitations

This refers to all natural, atmospheric, and other conditions which reduce visibility or otherwise excessively hinder a driver's or pedestrian's ability to see. This category thus includes the influence of fog, haze, rain, snow, and glare from the sun or headlights, on vision and/or visibility.

4. Avoidance obstructions

This category refers to objects which are located excessively close to road surfaces, and thereby close off evasive routes to a driver which (1) he did in fact consider, and which (2) were feasible escape routes, and which (3) he was reasonable in expecting would be available to him. Examples include traffic stopped or parked on the road brim, and trees or other fixed objects interrupting an otherwise relatively continuous road shoulder.

5. Rapid weather change

This refers to situations where a change in weather is so rapidly encountered as to surprise the driver, and thereby subjects him to an increased risk of involvement which he did not intend to generate. The key element is that of surprise, and a rate of change so great that it significantly exceeds normal expectations.

6. Camouflage effect

This category refers to situations where a traffic unit (e.g., motor vehicle or pedestrian) blended into its background to such a significant extent that its perception was delayed or even totally negated.

7. Environmental overload

Environmental overload refers to situations where so many simultaneous circumstances requiring monitoring by the driver occur, that he cannot successfully monitor all of them, so that despite being alert in attempting to cope with the situation, he fails to adequately monitor an item of information required for safe completion of the driving task, and is therefore involved in an accident.

APPENDIX A: PHASE II, III, IV, AND V CAUSAL RESULT DETAILED DATA TABLES

DETAILED HUMAN CAUSATION SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL		S/I		CAUSAL OR S/I	
			N	0/0	N	0/0	N	0/0
II. HUMAN FACTORS	CERTAIN	C	297	70.7	2	.5	299	71.2
		B	1451	64.3	5	.2	1456	64.5
	CERTAIN OR PROBABLE	C	388	92.4	1	.2	389	92.6
		B	2034	90.1	6	.3	2040	90.3
	CERTAIN PROBABLE OR POSSIBLE	C	409	97.4	2	.5	411	97.9
		B	2144	95.0	9	.4	2153	95.3
II. A. DIRECT HUMAN CAUSES	CERTAIN	C	296	70.5	2	.5	298	71.0
		B	1393	61.7	6	.3	1399	62.0
	CERTAIN OR PROBABLE	C	387	92.1	1	.2	388	92.4
		B	1976	87.5	10	.4	1986	88.0
	CERTAIN PROBABLE OR POSSIBLE	C	407	96.9	2	.5	409	97.4
		B	2093	92.7	14	.6	2107	93.3
1.0 CRITICAL NON-PERFORMANCE	CERTAIN	C	7	1.7	0	0.0	7	1.7
		B	25	1.1	0	0.0	25	1.1
	CERTAIN OR PROBABLE	C	9	2.1	0	0.0	9	2.1
		B	30	1.3	1	.0	31	1.4
	CERTAIN PROBABLE OR POSSIBLE	C	11	2.6	0	0.0	11	2.6
		B	32	1.4	1	.0	33	1.5
1.1 BLACKOUT	CERTAIN	C	2	.5	0	0.0	2	.5
		B	13	.6	0	0.0	13	.6
	CERTAIN OR PROBABLE	C	2	.5	0	0.0	2	.5
		B	16	.7	1	.0	17	.8
	CERTAIN PROBABLE OR POSSIBLE	C	2	.5	0	0.0	2	.5
		B	17	.8	1	.0	18	.8

DETAILED HUMAN CAUSATION SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
1.2 FELL ASLEEP/ DOZING	CERTAIN	C	5	1.2	0	0.0	5	1.2
		B	12	.5	0	0.0	12	.5
	CERTAIN OR PROBABLE	C	7	1.7	0	0.0	7	1.7
		B	14	.6	0	0.0	14	.6
	CERTAIN PROBABLE OR POSSIBLE	C	9	2.1	0	0.0	9	2.1
		B	15	.7	0	0.0	15	.7
2.0 NON-ACCIDENT (E.G., SUICIDE ATTEMPT)	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
3.0 RECOGNITION ERRORS	CERTAIN	C	174	41.4	0	0.0	174	41.4
		B	752	33.3	2	.1	754	33.4
	CERTAIN OR PROBABLE	C	235	56.0	0	0.0	235	56.0
		B	1143	50.6	6	.3	1149	50.9
	CERTAIN PROBABLE OR POSSIBLE	C	261	62.1	0	0.0	261	62.1
		B	1239	54.9	9	.4	1248	55.3
3.1 DRIVER FAILED TO OBSERVE AND STOP FOR STOP SIGN (SPECIAL TABULATION)	CERTAIN	C	26	6.2	0	0.0	26	6.2
		B	81	3.6	0	0.0	81	3.6
	CERTAIN OR PROBABLE	C	28	6.7	0	0.0	28	6.7
		B	99	4.4	0	0.0	99	4.4
	CERTAIN PROBABLE OR POSSIBLE	C	31	7.4	0	0.0	31	7.4
		B	105	4.7	0	0.0	105	4.7

DETAILED HUMAN CAUSATION SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
3.2 DELAYS IN RECOGNITION (FOR WHICH REASONS WERE IDENTIFIED)	CERTAIN	C	148	35.2	0	0.0	148	35.2
		B	643	28.5	1	.0	644	28.5
	CERTAIN OR PROBABLE	C	201	47.9	0	0.0	201	47.9
		B	979	43.4	4	.2	983	43.5
	CERTAIN PROBABLE OR POSSIBLE	C	224	53.3	0	0.0	224	53.3
		B	1066	47.2	7	.3	1073	47.5
3.2.1 INATTENTION	CERTAIN	C	41	9.8	0	0.0	41	9.8
		B	189	8.4	1	.0	190	8.4
	CERTAIN OR PROBABLE	C	63	15.0	0	0.0	63	15.0
		B	310	13.7	4	.2	314	13.9
	CERTAIN PROBABLE OR POSSIBLE	C	80	19.0	0	0.0	80	19.0
		B	353	15.6	5	.2	358	15.9
3.2.1.1 TO TRAFFIC STOP OR SLOWING AHEAD	CERTAIN	C	13	3.1	0	0.0	13	3.1
		B	89	3.9	0	0.0	89	3.9
	CERTAIN OR PROBABLE	C	23	5.5	0	0.0	23	5.5
		B	159	7.0	1	.0	160	7.1
	CERTAIN PROBABLE OR POSSIBLE	C	27	6.4	0	0.0	27	6.4
		B	170	7.5	2	.1	172	7.6
3.2.1.2 TO POSITION OF CAR ON ROAD	CERTAIN	C	7	1.7	0	0.0	7	1.7
		B	15	.7	0	0.0	15	.7
	CERTAIN OR PROBABLE	C	11	2.6	0	0.0	11	2.6
		B	24	1.1	0	0.0	24	1.1
	CERTAIN PROBABLE OR POSSIBLE	C	12	2.9	0	0.0	12	2.9
		B	27	1.2	0	0.0	27	1.2

DETAILED HUMAN CAUSATION SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
3.2.1.3 TO ROAD FEATURE (E.G., ONCOMING CURVES, LANE NARROWINGS,ETC.	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	5	.2	0	0.0	5	.2
	CERTAIN OR PROBABLE	C	3	.7	0	0.0	3	.7
		B	11	.5	0	0.0	11	.5
	CERTAIN PROBABLE OR POSSIBLE	C	6	1.4	0	0.0	6	1.4
		B	12	.5	0	0.0	12	.5
3.2.1.4 TO ROAD SIGNS, SIGNALS PROVIDING DRIVER INFORMATION	CERTAIN	C	16	3.8	0	0.0	16	3.8
		B	50	2.2	0	0.0	50	2.2
	CERTAIN OR PROBABLE	C	18	4.3	0	0.0	18	4.3
		B	70	3.1	0	0.0	70	3.1
	CERTAIN PROBABLE OR POSSIBLE	C	23	5.5	0	0.0	23	5.5
		B	79	3.5	0	0.0	79	3.5
3.2.1.5 TO CROSS-FLOWING TRAFFIC	CERTAIN	C	4	1.0	0	0.0	4	1.0
		B	23	1.0	0	0.0	23	1.0
	CERTAIN OR PROBABLE	C	7	1.7	0	0.0	7	1.7
		B	36	1.6	2	.1	38	1.7
	CERTAIN PROBABLE OR POSSIBLE	C	8	1.9	0	0.0	8	1.9
		B	53	2.3	3	.1	56	2.5
3.2.1.6 OTHER	CERTAIN	C	3	.7	0	0.0	3	.7
		B	8	.4	1	.0	9	.4
	CERTAIN OR PROBABLE	C	4	1.0	0	0.0	4	1.0
		B	13	.6	1	.0	14	.6
	CERTAIN PROBABLE OR POSSIBLE	C	7	1.7	0	0.0	7	1.7
		B	17	.8	1	.0	18	.8

DETAILED HUMAN CAUSATION SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
3.2.2 INTERNAL DISTRACTIONS	CERTAIN	C	24	5.7	0	0.0	24	5.7
		B	91	4.0	0	0.0	91	4.0
	CERTAIN OR PROBABLE	C	38	9.0	0	0.0	38	9.0
		B	135	6.0	2	.1	137	6.1
	CERTAIN PROBABLE OR POSSIBLE	C	46	11.0	0	0.0	46	11.0
		B	166	7.4	3	.1	169	7.5
3.2.2.1 EVENT IN CAR (LOUD NOISE, YELL, SCREAM, ETC.)	CERTAIN	C	5	1.2	0	0.0	5	1.2
		B	23	1.0	0	0.0	23	1.0
	CERTAIN OR PROBABLE	C	7	1.7	0	0.0	7	1.7
		B	35	1.6	0	0.0	35	1.6
	CERTAIN PROBABLE OR POSSIBLE	C	11	2.6	0	0.0	11	2.6
		B	38	1.7	0	0.0	38	1.7
3.2.2.2 ADJUSTING RADIO OR TAPE PLAYER	CERTAIN	C	5	1.2	0	0.0	5	1.2
		B	12	.5	0	0.0	12	.5
	CERTAIN OR PROBABLE	C	6	1.4	0	0.0	6	1.4
		B	15	.7	0	0.0	15	.7
	CERTAIN PROBABLE OR POSSIBLE	C	6	1.4	0	0.0	6	1.4
		B	16	.7	0	0.0	16	.7
3.2.2.3 ADJUSTING WINDOWS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	5	.2	0	0.0	5	.2
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	5	.2	1	.0	6	.3
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	6	.3	1	.0	7	.3

DETAILED HUMAN CAUSATION SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
3.2.2.4 CONVERSATION	CERTAIN	C	9	2.1	0	0.0	9	2.1
		B	22	1.0	0	0.0	22	1.0
	CERTAIN OR PROBABLE	C	15	3.6	0	0.0	15	3.6
		B	48	2.1	0	0.0	48	2.1
	CERTAIN PROBABLE OR POSSIBLE	C	18	4.3	0	0.0	18	4.3
		B	61	2.7	0	0.0	61	2.7
3.2.2.5 OTHER	CERTAIN	C	6	1.4	0	0.0	6	1.4
		B	29	1.3	0	0.0	29	1.3
	CERTAIN OR PROBABLE	C	11	2.6	0	0.0	11	2.6
		B	33	1.5	1	.0	34	1.5
	CERTAIN PROBABLE OR POSSIBLE	C	12	2.9	0	0.0	12	2.9
		B	46	2.0	2	.1	48	2.1
3.2.3 EXTERNAL DISTRACTION	CERTAIN	C	14	3.3	0	0.0	14	3.3
		B	86	3.8	0	0.0	86	3.8
	CERTAIN OR PROBABLE	C	18	4.3	0	0.0	18	4.3
		B	115	5.1	0	0.0	115	5.1
	CERTAIN PROBABLE OR POSSIBLE	C	23	5.5	0	0.0	23	5.5
		B	131	5.8	1	.0	132	5.8
3.2.3.1 OTHER TRAFFIC	CERTAIN	C	2	.5	0	0.0	2	.5
		B	21	.9	0	0.0	21	.9
	CERTAIN OR PROBABLE	C	3	.7	0	0.0	3	.7
		B	29	1.3	0	0.0	29	1.3
	CERTAIN PROBABLE OR POSSIBLE	C	3	.7	0	0.0	3	.7
		B	34	1.5	0	0.0	34	1.5

DETAILED HUMAN CAUSATION SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
3.2.3.2 DRIVER-SELECTED OUTSIDE ACTIVITY	CERTAIN	C	8	1.9	0	0.0	8	1.9
		B	40	1.8	0	0.0	40	1.8
	CERTAIN OR PROBABLE	C	10	2.4	0	0.0	10	2.4
		B	53	2.3	0	0.0	53	2.3
	CERTAIN PROBABLE OR POSSIBLE	C	11	2.6	0	0.0	11	2.6
		B	57	2.5	1	.0	58	2.6
3.2.3.3 ACTIVITY OF INTEREST OUTSIDE VEHICLE (FIST FIGHT ETC.)	CERTAIN	C	2	.5	0	0.0	2	.5
		B	12	.5	0	0.0	12	.5
	CERTAIN OR PROBABLE	C	2	.5	0	0.0	2	.5
		B	15	.7	0	0.0	15	.7
	CERTAIN PROBABLE OR POSSIBLE	C	4	1.0	0	0.0	4	1.0
		B	18	.8	0	0.0	18	.8
3.2.3.4 SUDDEN EVENT OUTSIDE VEHICLE (EXPLOSION, ETC.)	CERTAIN	C	1	.2	0	0.0	1	.2
		B	1	.0	0	0.0	1	.0
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	1	.0	0	0.0	1	.0
	CERTAIN PROBABLE OR POSSIBLE	C	2	.5	0	0.0	2	.5
		B	2	.1	0	0.0	2	.1
3.2.3.5 OTHER	CERTAIN	C	1	.2	0	0.0	1	.2
		B	12	.5	0	0.0	12	.5
	CERTAIN OR PROBABLE	C	2	.5	0	0.0	2	.5
		B	17	.8	0	0.0	17	.8
	CERTAIN PROBABLE OR POSSIBLE	C	3	.7	0	0.0	3	.7
		B	20	.9	0	0.0	20	.9

DETAILED HUMAN CAUSATION SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
3.2.4 IMPROPER LOOKOUT	CERTAIN	C	74	17.6	0	0.0	74	17.6
		B	294	13.0	0	0.0	294	13.0
	CERTAIN OR PROBABLE	C	97	23.1	0	0.0	97	23.1
		B	457	20.2	1	.0	458	20.3
	CERTAIN PROBABLE OR POSSIBLE	C	99	23.6	0	0.0	99	23.6
		B	485	21.5	3	.1	488	21.6
3.2.4.1 PULLING OUT FROM PARKING PLACE	CERTAIN	C	5	1.2	0	0.0	5	1.2
		B	31	1.4	0	0.0	31	1.4
	CERTAIN OR PROBABLE	C	6	1.4	0	0.0	6	1.4
		B	44	1.9	0	0.0	44	1.9
	CERTAIN PROBABLE OR POSSIBLE	C	6	1.4	0	0.0	6	1.4
		B	46	2.0	0	0.0	46	2.0
3.2.4.2 ENTERING TRAVEL LANE FROM INTERSECTING STREET OR ALLEY	CERTAIN	C	51	12.1	0	0.0	51	12.1
		B	170	7.5	0	0.0	170	7.5
	CERTAIN OR PROBABLE	C	69	16.4	0	0.0	69	16.4
		B	279	12.4	0	0.0	279	12.4
	CERTAIN PROBABLE OR POSSIBLE	C	70	16.7	0	0.0	70	16.7
		B	297	13.2	1	.0	298	13.2
3.2.4.3 PRIOR TO CHANGING LANES OR PASSING	CERTAIN	C	8	1.9	0	0.0	8	1.9
		B	41	1.8	0	0.0	41	1.8
	CERTAIN OR PROBABLE	C	9	2.1	0	0.0	9	2.1
		B	61	2.7	1	.0	62	2.7
	CERTAIN PROBABLE OR POSSIBLE	C	9	2.1	0	0.0	9	2.1
		B	67	3.0	1	.0	68	3.0

DETAILED HUMAN CAUSATION SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL O/O	S/I N	S/I O/O	CAUSAL OR S/I N	CAUSAL OR S/I O/O
3.2.4.4 OTHER	CERTAIN	C	11	2.6	0	0.0	11	2.6
		B	52	2.3	1	.0	53	2.3
	CERTAIN OR PROBABLE	C	17	4.0	0	0.0	17	4.0
		B	74	3.3	1	.0	75	3.3
	CERTAIN PROBABLE OR POSSIBLE	C	18	4.3	0	0.0	18	4.3
		B	78	3.5	2	.1	80	3.5
3.3 DELAYS IN PERCEPTION FOR OTHER OR UNKNOWN REASONS	CERTAIN	C	18	4.3	0	0.0	18	4.3
		B	62	2.7	1	.0	63	2.8
	CERTAIN OR PROBABLE	C	31	7.4	0	0.0	31	7.4
		B	117	5.2	1	.0	118	5.2
	CERTAIN PROBABLE OR POSSIBLE	C	42	10.0	1	.2	43	10.2
		B	141	6.2	1	.0	142	6.3
3.3.1 OF TRAFFIC STOPPED OR SLOWING AHEAD	CERTAIN	C	10	2.4	0	0.0	10	2.4
		B	26	1.2	0	0.0	26	1.2
	CERTAIN OR PROBABLE	C	14	3.3	0	0.0	14	3.3
		B	52	2.3	0	0.0	52	2.3
	CERTAIN PROBABLE OR POSSIBLE	C	17	4.0	1	.2	18	4.3
		B	62	2.7	0	0.0	62	2.7
3.3.2 OF POSITION OF CAR ON ROAD	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.1	0	0.0	2	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	5	.2	0	0.0	5	.2
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	5	.2	0	0.0	5	.2

DETAILED HUMAN CAUSATION SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
3.3.3 OF ROAD FEATURES (SUCH AS ON-COMING CURVES, LANE NARROWINGS, ETC	CERTAIN	C	1	.2	0	0.0	1	.2
		B	5	.2	0	0.0	5	.2
	CERTAIN OR PROBABLE	C	3	.7	0	0.0	3	.7
		B	13	.6	0	0.0	13	.6
	CERTAIN PROBABLE OR POSSIBLE	C	4	1.0	0	0.0	4	1.0
		B	16	.7	0	0.0	16	.7
3.3.4 OF ROAD SIGNS OR SIGNALS PROVIDING DRIVER INFORMATION	CERTAIN	C	3	.7	0	0.0	3	.7
		B	14	.6	0	0.0	14	.6
	CERTAIN OR PROBABLE	C	6	1.4	0	0.0	6	1.4
		B	20	.9	0	0.0	20	.9
	CERTAIN PROBABLE OR POSSIBLE	C	8	1.9	0	0.0	8	1.9
		B	25	1.1	0	0.0	25	1.1
3.3.5 OF CROSS-FLOWING TRAFFIC	CERTAIN	C	3	.7	0	0.0	3	.7
		B	10	.4	0	0.0	10	.4
	CERTAIN OR PROBABLE	C	6	1.4	0	0.0	6	1.4
		B	17	.8	0	0.0	17	.8
	CERTAIN PROBABLE OR POSSIBLE	C	8	1.9	0	0.0	8	1.9
		B	21	.9	0	0.0	21	.9
3.3.6 OTHER	CERTAIN	C	1	.2	0	0.0	1	.2
		B	6	.3	1	.0	7	.3
	CERTAIN OR PROBABLE	C	3	.7	0	0.0	3	.7
		B	11	.5	1	.0	12	.5
	CERTAIN PROBABLE OR POSSIBLE	C	5	1.2	0	0.0	5	1.2
		B	13	.6	1	.0	14	.6

DETAILED HUMAN CAUSATION SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
3.4 UNACCOUNTED FOR DELAYS IN COMPREHENSION OR REACTION	CERTAIN	C	2	.5	0	0.0	2	.5
		B	7	.3	0	0.0	7	.3
	CERTAIN OR PROBABLE	C	2	.5	0	0.0	2	.5
		B	24	1.1	4	.2	28	1.2
	CERTAIN PROBABLE OR POSSIBLE	C	2	.5	0	0.0	2	.5
		B	26	1.2	4	.2	30	1.3
3.4.1 DELAYED COMPREHENSION	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.1	0	0.0	2	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	11	.5	0	0.0	11	.5
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	11	.5	0	0.0	11	.5
3.4.2 DELAYED REACTION	CERTAIN	C	2	.5	0	0.0	2	.5
		B	5	.2	0	0.0	5	.2
	CERTAIN OR PROBABLE	C	2	.5	0	0.0	2	.5
		B	14	.6	4	.2	18	.8
	CERTAIN PROBABLE OR POSSIBLE	C	2	.5	0	0.0	2	.5
		B	16	.7	4	.2	20	.9
4.0 DECISION ERRORS	CERTAIN	C	120	28.6	2	.5	122	29.0
		B	676	29.9	12	.5	688	30.5
	CERTAIN OR PROBABLE	C	212	50.5	7	1.7	219	52.1
		B	1044	46.2	24	1.1	1068	47.3
	CERTAIN PROBABLE OR POSSIBLE	C	279	66.[illegible]	9	2.1	288	68.6
		B	1196	53.0	36	1.6	1232	54.6

DETAILED HUMAN CAUSATION SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
4.1 MISJUDGMENT OF DISTANCE, CLOSURE-RATE, ETC.	CERTAIN	C	9	2.1	0	0.0	9	2.1
		B	35	1.6	0	0.0	35	1.6
	CERTAIN OR PROBABLE	C	18	4.3	0	0.0	18	4.3
		B	57	2.5	0	0.0	57	2.5
	CERTAIN PROBABLE OR POSSIBLE	C	24	5.7	0	0.0	24	5.7
		B	64	2.8	0	0.0	64	2.8
4.2 FALSE ASSUMPTION	CERTAIN	C	19	4.5	0	0.0	19	4.5
		B	190	8.4	0	0.0	190	8.4
	CERTAIN OR PROBABLE	C	35	8.3	0	0.0	35	8.3
		B	263	11.6	4	.2	267	11.8
	CERTAIN PROBABLE OR POSSIBLE	C	43	10.2	0	0.0	43	10.2
		B	292	12.9	6	.3	298	13.2
4.2.1 ASSUMED OTHER DRIVER WAS REQUIRED TO STOP OR YIELD AT INTERSECTION	CERTAIN	C	3	.7	0	0.0	3	.7
		B	18	.8	0	0.0	18	.8
	CERTAIN OR PROBABLE	C	4	1.0	0	0.0	4	1.0
		B	28	1.2	0	0.0	28	1.2
	CERTAIN PROBABLE OR POSSIBLE	C	4	1.0	0	0.0	4	1.0
		B	34	1.5	0	0.0	34	1.5
4.2.2 ASSUMED OTHER DRIVER WOULD STOP/ YIELD WITHOUT ASSUMING REQUIREMENT	CERTAIN	C	1	.2	0	0.0	1	.2
		B	27	1.2	1	.0	28	1.2
	CERTAIN OR PROBABLE	C	4	1.0	0	0.0	4	1.0
		B	39	1.7	1	.0	40	1.8
	CERTAIN PROBABLE OR POSSIBLE	C	4	1.0	0	0.0	4	1.0
		B	44	1.9	2	.1	46	2.0

DETAILED HUMAN CAUSATION SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
4.2.3 ASSUMED ON-COMING CAR WOULD MOVE LEFT OR RIGHT, OUT OF WAY	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	5	.2	0	0.0	5	.2
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	11	.5	0	0.0	11	.5
	CERTAIN PROBABLE OR POSSIBLE	C	2	.5	0	0.0	2	.5
		B	13	.6	0	0.0	13	.6
4.2.4 ASSUMED VEHICLE WAS GOING TO TURN AND IT DID NOT	CERTAIN	C	3	.7	0	0.0	3	.7
		B	29	1.3	0	0.0	29	1.3
	CERTAIN OR PROBABLE	C	3	.7	0	0.0	3	.7
		B	30	1.3	0	0.0	30	1.3
	CERTAIN PROBABLE OR POSSIBLE	C	4	1.0	0	0.0	4	1.0
		B	31	1.4	0	0.0	31	1.4
4.2.5 ASSUMED NO TRAFFIC WAS COMING	CERTAIN	C	4	1.0	0	0.0	4	1.0
		B	56	2.5	0	0.0	56	2.5
	CERTAIN OR PROBABLE	C	9	2.1	0	0.0	9	2.1
		B	78	3.5	0	0.0	78	3.5
	CERTAIN PROBABLE OR POSSIBLE	C	9	2.1	0	0.0	9	2.1
		B	82	3.6	0	0.0	82	3.6
4.2.6 OTHER	CERTAIN	C	8	1.9	0	0.0	8	1.9
		B	57	2.5	0	0.0	57	2.5
	CERTAIN OR PROBABLE	C	15	3.6	0	0.0	15	3.6
		B	81	3.6	4	.2	85	3.8
	CERTAIN PROBABLE OR POSSIBLE	C	21	5.0	0	0.0	21	5.0
		B	93	4.1	5	.2	98	4.3

[illegible] HUMAN CAUSATION SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
4.3 IMPROPER MANEUVER	CERTAIN	C	21	5.0	0	0.0	21	5.0
		B	137	6.1	1	.0	138	6.1
	CERTAIN OR PROBABLE	C	26	6.2	0	0.0	26	6.2
		B	159	7.0	1	.0	160	7.1
	CERTAIN PROBABLE OR POSSIBLE	C	30	7.1	0	0.0	30	7.1
		B	165	7.3	1	.0	166	7.4
4.3.1 TURN FROM WRONG LANE	CERTAIN	C	9	2.1	0	0.0	9	2.1
		B	58	2.6	0	0.0	58	2.6
	CERTAIN OR PROBABLE	C	9	2.1	0	0.0	9	2.1
		B	64	2.8	0	0.0	64	2.8
	CERTAIN PROBABLE OR POSSIBLE	C	9	2.1	0	0.0	9	2.1
		B	65	2.9	0	0.0	65	2.9
4.3.2 DROVE IN WRONG LANE BUT CORRECT DIRECTION	CERTAIN	C	2	.5	0	0.0	2	.5
		B	16	.7	0	0.0	16	.7
	CERTAIN OR PROBABLE	C	2	.5	0	0.0	2	.5
		B	19	.8	0	0.0	19	.8
	CERTAIN PROBABLE OR POSSIBLE	C	2	.5	0	0.0	2	.5
		B	20	.9	0	0.0	20	.9
4.3.3 DROVE IN WRONG DIRECTION OF TRAVEL FOR LANE	CERTAIN	C	1	.2	0	0.0	1	.2
		B	15	.7	0	0.0	15	.7
	CERTAIN OR PROBABLE	C	2	.5	0	0.0	2	.5
		B	16	.7	0	0.0	16	.7
	CERTAIN PROBABLE OR POSSIBLE	C	3	.7	0	0.0	3	.7
		B	16	.7	0	0.0	16	.7

DETAILED HUMAN CAUSATION SUMMARY BY ACCIDENT FOR PHASES II, III, IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
4.3.4 PASSED AT IMPROPER LOCATION	CERTAIN	C	5	1.2	0	0.0	5	1.2
		B	25	1.1	0	0.0	25	1.1
	CERTAIN OR PROBABLE	C	7	1.7	0	0.0	7	1.7
		B	30	1.3	0	0.0	30	1.3
	CERTAIN PROBABLE OR POSSIBLE	C	7	1.7	0	0.0	7	1.7
		B	30	1.3	0	0.0	30	1.3
4.3.5 OTHER	CERTAIN	C	4	1.0	0	0.0	4	1.0
		B	25	1.1	1	.0	26	1.2
	CERTAIN OR PROBABLE	C	6	1.4	0	0.0	6	1.4
		B	32	1.4	1	.0	33	1.5
	CERTAIN PROBABLE OR POSSIBLE	C	9	2.1	0	0.0	9	2.1
		B	36	1.6	1	.0	37	1.6
4.4 IMPROPER DRIVING TECHNIQUE	CERTAIN	C	25	6.0	0	0.0	25	6.0
		B	55	2.4	0	0.0	55	2.4
	CERTAIN OR PROBABLE	C	38	9.0	0	0.0	38	9.0
		B	86	3.8	2	.1	88	3.9
	CERTAIN PROBABLE OR POSSIBLE	C	52	12.4	0	0.0	52	12.4
		B	106	4.7	3	.1	109	4.8
4.4.1 CRESTING HILLS, DRIVING IN CENTER OF ROAD	CERTAIN	C	3	.7	0	0.0	3	.7
		B	11	.5	0	0.0	11	.5
	CERTAIN OR PROBABLE	C	6	1.4	0	0.0	6	1.4
		B	13	.6	0	0.0	13	.6
	CERTAIN PROBABLE OR POSSIBLE	C	7	1.7	0	0.0	7	1.7
		B	16	.7	0	0.0	16	.7

DETAILED HUMAN CAUSATION SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
4.4.2 BRAKING LATER THAN SHOULD HAVE OR AT INAPPROPRIATE LOCATION	CERTAIN	C	3	.7	0	0.0	3	.7
		B	3	.1	0	0.0	3	.1
	CERTAIN OR PROBABLE	C	4	1.0	0	0.0	4	1.0
		B	7	.3	1	.0	8	.4
	CERTAIN PROBABLE OR POSSIBLE	C	5	1.2	0	0.0	5	1.2
		B	8	.4	1	.0	9	.4
4.4.3 STOPPING TOO FAR OUT IN ROAD OR INTERSECTION	CERTAIN	C	3	.7	0	0.0	3	.7
		B	4	.2	0	0.0	4	.2
	CERTAIN OR PROBABLE	C	4	1.0	0	0.0	4	1.0
		B	4	.2	0	0.0	4	.2
	CERTAIN PROBABLE OR POSSIBLE	C	4	1.0	0	0.0	4	1.0
		B	5	.2	0	0.0	5	.2
4.4.4 DRIVING TOO CLOSE TO CENTER LINE OR EDGE OF ROAD	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	3	.1	0	0.0	3	.1
	CERTAIN OR PROBABLE	C	3	.7	0	0.0	3	.7
		B	6	.3	0	0.0	6	.3
	CERTAIN PROBABLE OR POSSIBLE	C	4	1.0	0	0.0	4	1.0
		B	9	.4	1	.0	10	.4
4.4.5 SLOWED TOO RAPIDLY	CERTAIN	C	1	.2	0	0.0	1	.2
		B	2	.1	0	0.0	2	.1
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	8	.4	1	.0	9	.4
	CERTAIN PROBABLE OR POSSIBLE	C	2	.5	0	0.0	2	.5
		B	13	.6	1	.0	14	.6

DETAILED HUMAN CAUSATION SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
4.4.6 OTHER	CERTAIN	C	17	4.0	0	0.0	17	4.0
		B	32	1.4	0	0.0	32	1.4
	CERTAIN OR PROBABLE	C	24	5.7	0	0.0	24	5.7
		B	48	2.1	0	0.0	48	2.1
	CERTAIN PROBABLE OR POSSIBLE	C	34	8.1	0	0.0	34	8.1
		B	56	2.5	0	0.0	56	2.5
4.5 DRIVING TECHNIQUE WAS INADEQUATELY DEFENSIVE	CERTAIN	C	10	2.4	1	.2	11	2.6
		B	53	2.3	1	.0	54	2.4
	CERTAIN OR PROBABLE	C	35	8.3	2	.5	37	8.8
		B	106	4.7	4	.2	110	4.9
	CERTAIN PROBABLE OR POSSIBLE	C	56	13.3	3	.7	59	14.0
		B	141	6.2	5	.2	146	6.5
4.5.1 SHOULD HAVE POSITIONED CAR DIFFERENTLY	CERTAIN	C	1	.2	0	0.0	1	.2
		B	11	.5	0	0.0	11	.5
	CERTAIN OR PROBABLE	C	2	.5	0	0.0	2	.5
		B	19	.8	0	0.0	19	.8
	CERTAIN PROBABLE OR POSSIBLE	C	5	1.2	0	0.0	5	1.2
		B	21	.9	0	0.0	21	.9
4.5.2 SHOULD HAVE ADJUSTED SPEED	CERTAIN	C	6	1.4	1	.2	7	1.7
		B	23	1.0	1	.0	24	1.1
	CERTAIN OR PROBABLE	C	16	3.8	2	.5	18	4.3
		B	53	2.3	4	.2	57	2.5
	CERTAIN PROBABLE OR POSSIBLE	C	31	7.4	3	.7	34	8.1
		B	73	3.2	5	.2	78	3.5

DETAILED HUMAN CAUSATION SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
4.5.3 SHOULD NOT HAVE TAKEN DRIVERS ADHERENCE-TRAFFIC CONTROL FOR GRANTED	CERTAIN	C	1	.2	0	0.0	1	.2
		B	13	.6	0	0.0	13	.6
	CERTAIN OR PROBABLE	C	10	2.4	0	0.0	10	2.4
		B	22	1.0	0	0.0	22	1.0
	CERTAIN PROBABLE OR POSSIBLE	C	11	2.6	0	0.0	11	2.6
		B	31	1.4	0	0.0	31	1.4
4.5.4 OTHER	CERTAIN	C	2	.5	0	0.0	2	.5
		B	7	.3	0	0.0	7	.3
	CERTAIN OR PROBABLE	C	8	1.9	0	0.0	8	1.9
		B	13	.6	0	0.0	13	.6
	CERTAIN PROBABLE OR POSSIBLE	C	13	3.1	0	0.0	13	3.1
		B	17	.8	0	0.0	17	.8
4.6 EXCESSIVE SPEED	CERTAIN	C	33	7.9	0	0.0	33	7.9
		B	161	7.1	9	.4	170	7.5
	CERTAIN OR PROBABLE	C	67	16.0	4	1.0	71	16.9
		B	312	13.8	19	.8	331	14.7
	CERTAIN PROBABLE OR POSSIBLE	C	80	19.0	4	1.0	84	20.0
		B	370	16.4	27	1.2	397	17.6
4.6.1 FOR ROAD DESIGN REGARDLESS OF CONDITION OR TRAFFIC	CERTAIN	C	25	6.0	0	0.0	25	6.0
		B	108	4.8	4	.2	112	5.0
	CERTAIN OR PROBABLE	C	39	9.3	4	1.0	43	10.2
		B	180	8.0	8	.4	188	8.3
	CERTAIN PROBABLE OR POSSIBLE	C	46	11.0	4	1.0	50	11.9
		B	202	8.9	10	.4	212	9.4

DETAILED HUMAN CAUSATION SUMMARY BY ACCIDENT FOR PHASES II, III, IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
4.6.2 ONLY IN LIGHT OF TRAFFIC, PEDESTRIANS, ETC.	CERTAIN	C	3	.7	0	0.0	3	.7
		B	17	.8	2	.1	19	.8
	CERTAIN OR PROBABLE	C	4	1.0	0	0.0	4	1.0
		B	37	1.6	6	.3	43	1.9
	CERTAIN PROBABLE OR POSSIBLE	C	5	1.2	0	0.0	5	1.2
		B	48	2.1	7	.3	55	2.4
4.6.3 SOLELY IN LIGHT OF WEATHER CONDITIONS	CERTAIN	C	1	.2	0	0.0	1	.2
		B	17	.8	0	0.0	17	.8
	CERTAIN OR PROBABLE	C	12	2.9	0	0.0	12	2.9
		B	46	2.0	0	0.0	46	2.0
	CERTAIN PROBABLE OR POSSIBLE	C	15	3.6	0	0.0	15	3.6
		B	63	2.8	2	.1	65	2.9
4.6.4 DUE TO COMBINATIONS OF ABOVE FACTORS	CERTAIN	C	3	.7	0	0.0	3	.7
		B	18	.8	3	.1	21	.9
	CERTAIN OR PROBABLE	C	9	2.1	0	0.0	9	2.1
		B	44	1.9	5	.2	49	2.2
	CERTAIN PROBABLE OR POSSIBLE	C	10	2.4	0	0.0	10	2.4
		B	52	2.3	8	.4	60	2.7
4.6.5 OTHER	CERTAIN	C	1	.2	0	0.0	1	.2
		B	2	.1	0	0.0	2	.1
	CERTAIN OR PROBABLE	C	3	.7	0	0.0	3	.7
		B	8	.4	0	0.0	8	.4
	CERTAIN PROBABLE OR POSSIBLE	C	4	1.0	0	0.0	4	1.0
		B	8	.4	0	0.0	8	.4

DETAILED HUMAN CAUSATION SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
4.7 FOLLOWING TOO CLOSELY	CERTAIN	C	1	.2	0	0.0	1	.2
		B	12	.5	0	0.0	12	.5
	CERTAIN OR PROBABLE	C	5	1.2	0	0.0	5	1.2
		B	25	1.1	1	.0	26	1.2
	CERTAIN PROBABLE OR POSSIBLE	C	9	2.1	0	0.0	9	2.1
		B	36	1.6	1	.0	37	1.6
4.8 INADEQUATE SIGNAL	CERTAIN	C	2	.5	0	0.0	2	.5
		B	15	.7	0	0.0	15	.7
	CERTAIN OR PROBABLE	C	12	2.9	0	0.0	12	2.9
		B	27	1.2	2	.1	29	1.3
	CERTAIN PROBABLE OR POSSIBLE	C	30	7.1	0	0.0	30	7.1
		B	53	2.3	4	.2	57	2.5
4.8.1 FAILURE TO SIGNAL FOR TURN	CERTAIN	C	1	.2	0	0.0	1	.2
		B	7	.3	0	0.0	7	.3
	CERTAIN OR PROBABLE	C	4	1.0	0	0.0	4	1.0
		B	13	.6	1	.0	14	.6
	CERTAIN PROBABLE OR POSSIBLE	C	6	1.4	0	0.0	6	1.4
		B	34	1.5	2	.1	36	1.6
4.8.2 FAILURE TO USE HORN TO WARN	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	3	.1	0	0.0	3	.1
	CERTAIN OR PROBABLE	C	6	1.4	0	0.0	6	1.4
		B	5	.2	1	.0	6	.3
	CERTAIN PROBABLE OR POSSIBLE	C	23	5.5	0	0.0	23	5.5
		B	10	.4	2	.1	12	.5

DETAILED HUMAN CAUSATION SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
4.8.3 OTHER	CERTAIN	C	1	.2	0	0.0	1	.2
		B	5	.2	0	0.0	5	.2
	CERTAIN OR PROBABLE	C	2	.5	0	0.0	2	.5
		B	9	.4	0	0.0	9	.4
	CERTAIN PROBABLE OR POSSIBLE	C	3	.7	0	0.0	3	.7
		B	10	.4	0	0.0	10	.4
4.9 FAILURE TO TURN ON HEADLIGHTS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.1	0	0.0	2	.1
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	3	.1	0	0.0	3	.1
	CERTAIN PROBABLE OR POSSIBLE	C	3	.7	0	0.0	3	.7
		B	5	.2	0	0.0	5	.2
4.10 EXCESSIVE ACCELERATION (LOSS OF CONTROL)	CERTAIN	C	1	.2	0	0.0	1	.2
		B	8	.4	0	0.0	6	.4
	CERTAIN OR PROBABLE	C	3	.7	0	0.0	3	.7
		B	12	.5	0	0.0	12	.5
	CERTAIN PROBABLE OR POSSIBLE	C	4	1.0	0	0.0	4	1.0
		B	16	.7	0	0.0	16	.7
4.11 PEDESTRIAN RAN INTO TRAFFIC	CERTAIN	C	2	.5	0	0.0	2	.5
		B	5	.2	0	0.0	5	.2
	CERTAIN OR PROBABLE	C	3	.7	0	0.0	3	.7
		B	7	.3	0	0.0	7	.3
	CERTAIN PROBABLE OR POSSIBLE	C	3	.7	0	0.0	3	.7
		B	7	.3	0	0.0	7	.3

DETAILED HUMAN CAUSATION SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
4.12 IMPROPER EVASIVE ACTION	CERTAIN	C	20	4.8	1	.2	21	5.0
		B	101	4.5	5	.2	106	4.7
	CERTAIN OR PROBABLE	C	53	12.6	3	.7	56	13.3
		B	220	9.7	12	.5	232	10.3
	CERTAIN PROBABLE OR POSSIBLE	C	91	21.7	4	1.0	95	22.6
		B	271	12.0	26	1.2	297	13.2
4.12.1 DRIVERS EVASIVE STEER WAS INEFFECTIVE DUE TO LOCKED FRONT WHEELS	CERTAIN	C	8	1.9	0	0.0	8	1.9
		B	43	1.9	2	.1	45	2.0
	CERTAIN OR PROBABLE	C	20	4.8	0	0.0	20	4.8
		B	98	4.3	3	.1	101	4.5
	CERTAIN PROBABLE OR POSSIBLE	C	36	8.6	1	.2	37	8.8
		B	108	4.8	3	.1	111	4.9
4.12.2 DRIVER DID NOT ATTEMPT APPROPRIATE EVASIVE STEER	CERTAIN	C	8	1.9	1	.2	9	2.1
		B	37	1.6	1	.0	38	1.7
	CERTAIN OR PROBABLE	C	18	4.3	1	.2	19	4.5
		B	78	3.5	9	.4	87	3.9
	CERTAIN PROBABLE OR POSSIBLE	C	32	7.6	2	.5	34	8.1
		B	100	4.4	17	.8	117	5.2
4.12.3 DRIVER COULD HAVE ACCELERATED OUT OF DANGER, BUT DID NOT	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	6	.3	2	.1	8	.4
	CERTAIN OR PROBABLE	C	3	.7	1	.2	4	1.0
		B	12	.5	3	.1	15	.7
	CERTAIN PROBABLE OR POSSIBLE	C	11	2.6	1	.2	12	2.9
		B	28	1.2	6	.3	34	1.5

DETAILED HUMAN CAUSATION SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
4.12.4 OTHER	CERTAIN	C	6	1.4	0	0.0	6	1.4
		B	18	.8	0	0.0	18	.8
	CERTAIN OR PROBABLE	C	17	4.0	1	.2	18	4.3
		B	37	1.6	0	0.0	37	1.6
	CERTAIN PROBABLE OR POSSIBLE	C	23	5.5	3	.7	26	6.2
		B	48	2.1	5	.2	53	2.3
4.13 OTHER DECISION ERRORS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.1	0	0.0	2	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	4	.2	0	0.0	4	.2
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	5	.2	0	0.0	5	.2
5.0 PERFORMANCE ERRORS	CERTAIN	C	29	6.9	0	0.0	29	6.9
		B	131	5.8	2	.1	133	5.9
	CERTAIN OR PROBABLE	C	47	11.2	0	0.0	47	11.2
		B	202	8.9	6	.3	208	9.2
	CERTAIN PROBABLE OR POSSIBLE	C	58	13.8	1	.2	59	14.0
		B	241	10.7	8	.4	249	11.0
5.1 OVERCOMPENSATION	CERTAIN	C	14	3.3	0	0.0	14	3.3
		B	41	1.8	2	.1	43	1.9
	CERTAIN OR PROBABLE	C	25	6.0	0	0.0	25	6.0
		B	69	3.1	3	.1	72	3.2
	CERTAIN PROBABLE OR POSSIBLE	C	29	6.9	0	0.0	29	6.9
		B	84	3.7	5	.2	89	3.9

DETAILED HUMAN CAUSATION SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL O/O	S/I N	S/I O/O	CAUSAL OR S/I N	CAUSAL OR S/I O/O
5.2 PANIC OR FREEZING	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	13	.6	1	.0	14	.6
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	31	1.4	6	.3	37	1.6
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	47	2.1	6	.3	53	2.3
5.3 INADEQUATE DIRECTIONAL CONTROL	CERTAIN	C	14	3.3	0	0.0	14	3.3
		B	67	3.0	0	0.0	67	3.0
	CERTAIN OR PROBABLE	C	19	4.5	0	0.0	19	4.5
		B	92	4.1	1	.0	93	4.1
	CERTAIN PROBABLE OR POSSIBLE	C	28	6.7	1	.2	29	6.9
		B	98	4.3	1	.0	99	4.4
5.3.1 ON CURVE-- ALLOWED CAR TO ENTER OPPOSING LANE OF TRAVEL	CERTAIN	C	3	.7	0	0.0	3	.7
		B	14	.6	0	0.0	14	.6
	CERTAIN OR PROBABLE	C	6	1.4	0	0.0	6	1.4
		B	22	1.0	0	0.0	22	1.0
	CERTAIN PROBABLE OR POSSIBLE	C	10	2.4	0	0.0	10	2.4
		B	22	1.0	0	0.0	22	1.0
5.3.2 ON STRAIGHT- -ALLOWED CAR TO ENTER OPPOSING LANE OF TRAVEL	CERTAIN	C	1	.2	0	0.0	1	.2
		B	7	.3	0	0.0	7	.3
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	10	.4	0	0.0	10	.4
	CERTAIN PROBABLE OR POSSIBLE	C	2	.5	0	0.0	2	.5
		B	11	.5	0	0.0	11	.5

DETAILED HUMAN CAUSATION SUMMARY BY ACCIDENT FOR PHASES II, III, IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
5.3.3 ON STRAIGHT OR CURVE--ALLOWED CAR TO GO OFF RIGHT EDGE OF ROAD	CERTAIN	C	7	1.7	0	0.0	7	1.7
		B	35	1.6	0	0.0	35	1.6
	CERTAIN OR PROBABLE	C	9	2.1	0	0.0	9	2.1
		B	47	2.1	0	0.0	47	2.1
	CERTAIN PROBABLE OR POSSIBLE	C	11	2.6	1	.2	12	2.9
		B	50	2.2	0	0.0	50	2.2
5.3.4 ON STRAIGHT OR CURVE--NOT ABOVE BUT DID NOT STAY IN OWN LANE OF TRAVEL	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	5	.2	0	0.0	5	.2
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	6	.3	0	0.0	6	.3
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	7	.3	0	0.0	7	.3
5.3.5 OTHER	CERTAIN	C	3	.7	0	0.0	3	.7
		B	6	.3	0	0.0	6	.3
	CERTAIN OR PROBABLE	C	3	.7	0	0.0	3	.7
		B	7	.3	1	.0	8	.4
	CERTAIN PROBABLE OR POSSIBLE	C	5	1.2	0	0.0	5	1.2
		B	8	.4	1	.0	9	.4
5.4 OTHER PERFORMANCE	CERTAIN	C	2	.5	0	0.0	2	.5
		B	13	.6	0	0.0	13	.6
	CERTAIN OR PROBABLE	C	6	1.4	0	0.0	6	1.4
		B	17	.8	0	0.0	17	.8
	CERTAIN PROBABLE OR POSSIBLE	C	9	2.1	1	.2	10	2.4
		B	21	.9	0	0.0	21	.9

DETAILED HUMAN CAUSATION SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL		S/I		CAUSAL OR S/I	
			N	0/0	N	0/0	N	0/0
6.0 OTHER HUMAN CAUSAL FACTORS	CERTAIN	C	2	.5	0	0.0	2	.5
		B	5	.2	0	0.0	5	.2
	CERTAIN OR PROBABLE	C	3	.7	0	0.0	3	.7
		B	9	.4	1	.0	10	.4
	CERTAIN PROBABLE OR POSSIBLE	C	6	1.4	0	0.0	6	1.4
		B	17	.8	1	.0	18	.8

DETAILED HUMAN CONDITIONS AND STATES SUMMARY BY ACCIDENT FOR PHASES II THRU V

	Degree of Certainty	Level of Study	Causal N	Causal 0/0	S/I N	S/I 0/0	Causal or S/I N	Causal or S/I 0/0
II.B. HUMAN CONDITIONS OR STATES	CERTAIN	C	12	2.9	0	0.0	12	2.9
		B	126	5.6	0	0.0	126	5.6
	CERTAIN OR PROBABLE	C	52	12.4	0	0.0	52	12.4
		B	291	12.[illegible]	5	.2	296	13.1
	CERTAIN PROBABLE OR POSSIBLE	C	106	25.2	0	0.0	106	25.2
		B	398	17.6	10	.4	408	18.1
1.0 PHYSICAL/ PHYSIOLOGICAL	CERTAIN	C	6	1.4	0	0.0	6	1.4
		B	74	3.3	0	0.0	74	3.3
	CERTAIN OR PROBABLE	C	28	6.7	0	0.0	28	6.7
		B	160	7.1	3	.1	163	7.2
	CERTAIN PROBABLE OR POSSIBLE	C	57	13.6	0	0.0	57	13.6
		B	232	10.3	6	.3	238	10.5
1.1 ALCOHOL IMPAIRMENT	CERTAIN	C	2	.5	0	0.0	2	.5
		B	66	2.9	0	0.0	66	2.9
	CERTAIN OR PROBABLE	C	13	3.1	0	0.0	13	3.1
		B	135	6.0	2	.1	137	6.1
	CERTAIN PROBABLE OR POSSIBLE	C	24	5.7	0	0.0	24	5.7
		B	194	8.6	2	.1	196	8.7
1.2 OTHER DRUG IMPAIRMENT	CERTAIN	C	2	.5	0	0.0	2	.5
		B	5	.2	0	0.0	5	.2
	CERTAIN OR PROBABLE	C	9	2.1	0	0.0	9	2.1
		B	13	.6	0	0.0	13	.6
	CERTAIN PROBABLE OR POSSIBLE	C	17	4.0	0	0.0	17	4.0
		B	17	.8	2	.1	19	.8

DETAILED HUMAN CONDITIONS AND STATES SUMMARY BY ACCIDENT FOR PHASES II THRU V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
1.3 FATIGUE	CERTAIN	C	1	.2	0	0.0	1	.2
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	7	1.[illegible]	0	0.0	7	1.7
		B	7	.3	0	0.0	7	.3
	CERTAIN PROBABLE OR POSSIBLE	C	17	4.0	0	0.0	17	4.0
		B	14	.6	0	0.0	14	.6
1.4 PHYSICAL HANDICAP	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN PROBABLE OR POSSIBLE	C	2	.5	0	0.0	2	.5
		B	3	.1	0	0.0	3	.1
1.5 REDUCED VISION	CERTAIN	C	1	.2	0	0.0	1	.2
		B	1	.0	0	0.0	1	.0
	CERTAIN OR PROBABLE	C	2	.5	0	0.0	2	.5
		B	5	.2	0	0.0	5	.2
	CERTAIN PROBABLE OR POSSIBLE	C	8	1.9	0	0.0	8	1.9
		B	8	.4	2	.1	10	.4
1.6 CHRONIC ILLNESS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.0	1	.0	2	.1
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	2	.1	1	.0	3	.1

DETAILED HUMAN CONDITIONS AND STATES SUMMARY BY ACCIDENT FOR PHASES II THRU V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL O/O	S/I N	S/I O/O	CAUSAL OR S/I N	CAUSAL OR S/I O/O
2.0 MENTAL/ EMOTIONAL	CERTAIN	C	4	1.0	0	0.0	4	1.0
		B	15	.7	0	0.0	15	.7
	CERTAIN OR PROBABLE	C	12	2.9	0	0.0	12	2.9
		B	40	1.8	0	0.0	40	1.8
	CERTAIN PROBABLE OR POSSIBLE	C	30	7.1	0	0.0	30	7.1
		B	59	2.6	2	.1	61	2.7
2.1 EMOTIONAL UPSET	CERTAIN	C	1	.2	0	0.0	1	.2
		B	8	.4	0	0.0	8	.4
	CERTAIN OR PROBABLE	C	5	1.2	0	0.0	5	1.2
		B	16	.7	0	0.0	16	.7
	CERTAIN PROBABLE OR POSSIBLE	C	9	2.1	0	0.0	9	2.1
		B	25	1.1	0	0.0	25	1.1
2.2 PRESSURE FROM OTHER DRIVERS	CERTAIN	C	1	.2	0	0.0	1	.2
		B	2	.1	0	0.0	2	.1
	CERTAIN OR PROBABLE	C	3	.7	0	0.0	3	.7
		B	4	.2	0	0.0	4	.2
	CERTAIN PROBABLE OR POSSIBLE	C	7	1.7	0	0.0	7	1.7
		B	8	.4	0	0.0	8	.4
2.3 IN-HURRY	CERTAIN	C	2	.5	0	0.0	2	.5
		B	6	.3	0	0.0	6	.3
	CERTAIN OR PROBABLE	C	5	1.2	0	0.0	5	1.2
		B	22	1.0	0	0.0	22	1.0
	CERTAIN PROBABLE OR POSSIBLE	C	15	3.6	0	0.0	15	3.6
		B	27	1.2	2	.1	29	1.3

DETAILED HUMAN CONDITIONS AND STATES SUMMARY BY ACCIDENT FOR PHASES II THRU V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
2.4 MENTAL DEFICIENCY	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
3.0 EXPERIENCE/ EXPOSURE	CERTAIN	C	2	.5	0	0.0	2	.5
		B	37	1.6	0	0.0	37	1.6
	CERTAIN OR PROBABLE	C	12	2.9	0	0.0	12	2.9
		B	99	4.4	3	.1	102	4.5
	CERTAIN PROBABLE OR POSSIBLE	C	29	6.9	0	0.0	29	6.9
		B	131	5.8	5	.2	136	6.0
3.1 DRIVER INEXPERIENCE	CERTAIN	C	1	.2	0	0.0	1	.2
		B	5	.2	0	0.0	5	.2
	CERTAIN OR PROBABLE	C	6	1.4	0	0.0	6	1.4
		B	30	1.3	2	.1	32	1.4
	CERTAIN, PROBABLE OR POSSIBLE	C	9	2.1	0	0.0	9	2.1
		B	41	1.8	4	.2	45	2.0
3.2 VEHICLE UNFAMILIARITY	CERTAIN	C	1	.2	0	0.0	1	.2
		B	5	.2	0	0.0	5	.2
	CERTAIN OR PROBABLE	C	4	1.0	0	0.0	4	1.0
		B	16	.7	0	0.0	16	.7
	CERTAIN PROBABLE OR POSSIBLE	C	9	2.1	0	0.0	9	2.1
		B	23	1.0	1	.0	24	1.1

DETAILED HUMAN CONDITIONS AND STATES SUMMARY BY ACCIDENT FOR PHASES II THRU V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
3.3 ROAD OVER-FAMILIARITY	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	4	.2	0	0.0	4	.2
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	8	.4	1	.0	9	.4
	CERTAIN, PROBABLE OR POSSIBLE	C	2	.5	0	0.0	2	.5
		B	8	.4	1	.0	9	.4
3.4 ROAD/AREA UNFAMILIARITY	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	23	1.0	0	0.0	23	1.0
	CERTAIN OR PROBABLE	C	3	.7	0	0.0	3	.7
		B	48	2.1	0	0.0	48	2.1
	CERTAIN, PROBABLE OR POSSIBLE	C	12	2.9	0	0.0	12	2.9
		B	66	2.9	0	0.0	66	2.9

DETAILED ENVIRONMENTAL FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL O/O	S/I N	S/I O/O	CAUSAL OR S/I N	CAUSAL OR S/I O/O
III. ENVIRONMENTAL FACTORS-INCLUDING SLICK ROADS	CERTAIN	C	52	12.4	4	1.0	56	13.3
		B	427	18.9	39	1.7	466	20.6
	CERTAIN OR PROBABLE	C	134	31.9	8	1.9	142	33.8
		B	726	32.2	61	2.7	787	34.9
	CERTAIN PROBABLE OR POSSIBLE	C	186	44.3	7	1.7	193	46.0
		B	927	41.1	71	3.1	998	44.2
1.0 SLICK ROADS	CERTAIN	C	16	3.8	3	.7	19	4.5
		B	141	6.2	37	1.6	178	7.9
	CERTAIN OR PROBABLE	C	33	7.9	8	1.9	41	9.8
		B	248	11.0	70	3.1	318	14.1
	CERTAIN PROBABLE OR POSSIBLE	C	47	11.2	8	1.9	55	13.1
		B	293	13.0	90	4.0	383	17.0
1.1 ROAD WET	CERTAIN	C	4	1.0	2	.5	6	1.4
		B	61	2.7	28	1.2	89	3.9
	CERTAIN OR PROBABLE	C	13	3.1	6	1.4	19	4.5
		B	131	5.8	51	2.3	182	8.1
	CERTAIN PROBABLE OR POSSIBLE	C	22	5.2	6	1.4	28	6.7
		B	162	7.2	67	3.0	229	10.1
1.2 ROAD SNOW AND/ OR ICE COVERED	CERTAIN	C	11	2.6	0	0.0	11	2.6
		B	61	2.7	3	.1	64	2.8
	CERTAIN OR PROBABLE	C	15	3.6	0	0.0	15	3.6
		B	79	3.5	5	.2	84	3.7
	CERTAIN PROBABLE OR POSSIBLE	C	18	4.3	0	0.0	18	4.3
		B	85	3.8	5	.2	90	4.0

DETAILED ENVIRONMENTAL FACTORS SUMMARY BY ACCIDENT FOR PHASES II, III, IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
1.3 GRAVEL AND/OR SAND ON PAVEMENT	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	12	.5	7	.3	19	.8
	CERTAIN OR PROBABLE	C	4	1.0	0	0.0	4	1.0
		B	27	1.2	14	.6	41	1.8
	CERTAIN PROBABLE OR POSSIBLE	C	7	1.7	0	0.0	7	1.7
		B	34	1.5	18	.8	52	2.3
1.4 ROAD SLICK DUE TO TRAFFIC POLISHING	CERTAIN	C	0	0.0	1	.2	1	.2
		B	1	.0	1	.0	2	.1
	CERTAIN OR PROBABLE	C	0	0.0	2	.5	2	.5
		B	1	.0	1	.0	2	.1
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	2	.5	2	.5
		B	2	.1	1	.0	3	.1
1.5 WET AND TRAFFIC POLISHED ASPHALT	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	1	.2	1	.2
		B	2	.1	0	0.0	2	.1
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	1	.2	2	.5
		B	2	.1	0	0.0	2	.1
1.6 GRAVEL ROAD	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	3	.1	2	.1	5	.2
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	5	.2	3	.1	8	.4
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	6	.3	3	.1	9	.4

DETAILED ENVIRONMENTAL FACTORS SUMMARY BY ACCIDENT FOR PHASES II, III, IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
1.7 OTHER PROBLEMS	CERTAIN	C	1	.2	0	0.0	1	.2
		B	4	.2	0	0.0	4	.2
	CERTAIN OR PROBABLE	C	2	.5	0	0.0	2	.5
		B	7	.3	1	.0	8	.4
	CERTAIN PROBABLE OR POSSIBLE	C	2	.5	0	0.0	2	.5
		B	8	.4	1	.0	9	.4
2.0 ENVIRONMENTAL FACTORS--EXCLUDING 'SLICK ROADS'	CERTAIN	C	38	9.0	1	.2	39	9.3
		B	298	13.2	11	.5	309	13.7
	CERTAIN OR PROBABLE	C	108	25.7	2	.5	110	26.2
		B	523	23.2	17	.8	540	23.9
	CERTAIN PROBABLE OR POSSIBLE	C	155	36.9	2	.5	157	37.4
		B	706	31.3	22	1.0	728	32.2
2.1 HIGHWAY RELATED	CERTAIN	C	30	7.1	1	.2	31	7.4
		B	214	9.5	11	.5	225	10.0
	CERTAIN OR PROBABLE	C	86	20.5	2	.5	88	21.0
		B	382	16.9	15	.7	397	17.6
	CERTAIN PROBABLE OR POSSIBLE	C	116	27.6	2	.5	118	28.1
		B	511	22.6	22	1.0	533	23.6
2.1.1 CONTROL HINDRANCES	CERTAIN	C	5	1.2	1	.2	6	1.4
		B	29	1.3	10	.4	39	1.7
	CERTAIN OR PROBABLE	C	15	3.6	1	.2	16	3.8
		B	50	2.2	11	.5	61	2.7
	CERTAIN PROBABLE OR POSSIBLE	C	18	4.3	1	.2	19	4.5
		B	65	2.9	14	.6	79	3.5

DETAILED ENVIRONMENTAL FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
2.1.1.1 DROP-OFF AT PAVEMENT EDGE	CERTAIN	C	2	.5	0	0.0	2	.5
		B	14	.6	1	.0	15	.7
	CERTAIN OR PROBABLE	C	5	1.2	0	0.0	5	1.2
		B	22	1.0	2	.1	24	1.1
	CERTAIN PROBABLE OR POSSIBLE	C	5	1.2	0	0.0	5	1.2
		B	26	1.2	3	.1	29	1.3
2.1.1.2 EXCESSIVE ROAD CROWNS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.1	0	0.0	2	.1
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	3	.1	0	0.0	3	.1
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	4	.2	1	.0	5	.2
2.1.1.3 IMPROPERLY BANKED CURVES	CERTAIN	C	1	.2	0	0.0	1	.2
		B	2	.1	0	0.0	2	.1
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	5	.2	0	0.0	5	.2
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	10	.4	0	0.0	10	.4
2.1.1.4 SOFT SHOULDERS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	3	.1	0	0.0	3	.1
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	4	.2	0	0.0	4	.2

DETAILED ENVIRONMENTAL FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
2.1.1.5 DITCHES EMBANKMENTS, AND OTHER ROADSIDE FEATURES	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	6	.3	9	.4	15	.7
	CERTAIN OR PROBABLE	C	2	.5	0	0.0	2	.5
		B	11	.5	9	.4	20	.9
	CERTAIN PROBABLE OR POSSIBLE	C	3	.7	0	0.0	3	.7
		B	15	.7	9	.4	24	1.1
2.1.1.6 UNEXPECTED WET OR SLICK SPOTS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.1	0	0.0	2	.1
	CERTAIN OR PROBABLE	C	3	.7	0	0.0	3	.7
		B	2	.1	0	0.0	2	.1
	CERTAIN PROBABLE OR POSSIBLE	C	3	.7	0	0.0	3	.7
		B	2	.1	1	.0	3	.1
2.1.1.7 OTHER CONTROL HINDRANCES	CERTAIN	C	2	.5	1	.2	3	.7
		B	3	.1	1	.0	4	.2
	CERTAIN OR PROBABLE	C	3	.7	1	.2	4	1.0
		B	6	.3	1	.0	7	.3
	CERTAIN PROBABLE OR POSSIBLE	C	6	1.4	1	.2	7	1.7
		B	7	.3	2	.1	9	.4
2.1.2 INADEQUATE SIGNS AND SIGNALS	CERTAIN	C	4	1.0	0	0.0	4	1.0
		B	28	1.2	0	0.0	28	1.2
	CERTAIN OR PROBABLE	C	12	2.9	0	0.0	12	2.9
		B	68	3.0	1	.0	69	3.1
	CERTAIN PROBABLE OR POSSIBLE	C	23	5.5	0	0.0	23	5.5
		B	121	5.4	6	.3	127	5.6

DETAILED ENVIRONMENTAL FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
2.1.2.1 STOP SIGN NEEDED BUT NOT PROVIDED	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	10	.4	0	0.0	10	.4
	CERTAIN OR PROBABLE	C	3	.7	0	0.0	3	.7
		B	17	.8	0	0.0	17	.8
	CERTAIN PROBABLE OR POSSIBLE	C	3	.7	0	0.0	3	.7
		B	22	1.0	0	0.0	22	1.0
2.1.2.2 STOP SIGN PRESENT BUT NOT ADEQUATE	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	3	.1	0	0.0	3	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	6	.3	0	0.0	6	.3
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	10	.4	1	.0	11	.5
2.1.2.3 CURVE WARNING SIGNS NEEDED	CERTAIN	C	1	.2	0	0.0	1	.2
		B	2	.1	0	0.0	2	.1
	CERTAIN OR PROBABLE	C	2	.5	0	0.0	2	.5
		B	10	.4	0	0.0	10	.4
	CERTAIN PROBABLE OR POSSIBLE	C	4	1.0	0	0.0	4	1.0
		B	22	1.0	2	.1	24	1.1
2.1.2.4 CURVE SIGN PRESENT BUT NOT ADEQUATE	CERTAIN	C	2	.5	0	0.0	2	.5
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	3	.7	0	0.0	3	.7
		B	0	0.0	1	.0	1	.0
	CERTAIN PROBABLE OR POSSIBLE	C	5	1.2	0	0.0	5	1.2
		B	3	.1	1	.0	4	.2

DETAILED ENVIRONMENTAL FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
2.1.2.5 SIGNAL LIGHT POORLY PLACED AND/OR NOT ADEQUATELY VISIBLE	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	3	.1	1	.0	4	.2
2.1.2.6 POOR SIGNAL TIMING	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	3	.1	0	0.0	3	.1
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	3	.1	0	0.0	3	.1
2.1.2.7 CENTER OR LANE LINES NOT PRESENT OR INADE-QUATE	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	4	.2	0	0.0	4	.2
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	10	.4	0	0.0	10	.4
	CERTAIN PROBABLE OR POSSIBLE	C	4	1.0	0	0.0	4	1.0
		B	21	.9	0	0.0	21	.9
2.1.2.8 EDGE LINES NOT PRESENT OR INADEQUATE	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	3	.1	0	0.0	3	.1
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	6	.3	0	0.0	6	.3

DETAILED ENVIRONMENTAL FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
2.1.2.9 OTHER	CERTAIN	C	1	.2	0	0.0	1	.2
		B	10	.4	0	0.0	10	.4
	CERTAIN OR PROBABLE	C	3	.7	0	0.0	3	.7
		B	24	1.1	0	0.0	24	1.1
	CERTAIN PROBABLE OR POSSIBLE	C	7	1.7	0	0.0	7	1.7
		B	45	2.0	1	.0	46	2.0
2.1.3 VIEW OBSTRUCTIONS	CERTAIN	C	16	3.8	0	0.0	16	3.8
		B	132	5.8	0	0.0	132	5.8
	CERTAIN OR PROBABLE	C	50	11.9	1	.2	51	12.1
		B	247	10.9	2	.1	249	11.0
	CERTAIN PROBABLE OR POSSIBLE	C	66	15.7	3	.7	69	16.4
		B	324	14.3	5	.2	329	14.6
2.1.3.1 HILL-CRESTS, DIPS, ETC.	CERTAIN	C	3	.7	0	0.0	3	.7
		B	23	1.0	0	0.0	23	1.0
	CERTAIN OR PROBABLE	C	5	1.2	0	0.0	5	1.2
		B	42	1.9	0	0.0	42	1.9
	CERTAIN PROBABLE OR POSSIBLE	C	5	1.2	0	0.0	5	1.2
		B	57	2.5	1	.0	58	2.6
2.1.3.2 ROADSIDE EMBANKMENTS, ESCARPMENTS, ETC.	CERTAIN	C	4	1.0	0	0.0	4	1.0
		B	13	.6	0	0.0	13	.6
	CERTAIN OR PROBABLE	C	7	1.7	0	0.0	7	1.7
		B	19	.8	0	0.0	19	.8
	CERTAIN PROBABLE OR POSSIBLE	C	11	2.6	0	0.0	11	2.6
		B	28	1.2	0	0.0	28	1.2

DETAILED ENVIRONMENTAL FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
2.1.3.3 ROADSIDE STRUCTURES AND GROWTH	CERTAIN	C	4	1.0	0	0.0	4	1.0
		B	37	1.6	0	0.0	37	1.6
	CERTAIN OR PROBABLE	C	22	5.[illegible]	1	.2	23	5.5
		B	66	2.9	1	.0	67	3.0
	CERTAIN PROBABLE OR POSSIBLE	C	25	6.0	2	.5	27	6.4
		B	90	4.0	3	.1	93	4.1
2.1.3.4 STOPPED TRAFFIC(NON-PARKED)	CERTAIN	C	3	.7	0	0.0	3	.7
		B	22	1.0	0	0.0	22	1.0
	CERTAIN OR PROBABLE	C	8	1.9	0	0.0	8	1.9
		B	46	2.0	0	0.0	46	2.0
	CERTAIN PROBABLE OR POSSIBLE	C	11	2.6	0	0.0	11	2.6
		B	50	2.2	0	0.0	50	2.2
2.1.3.5 PARKED VEHICLES	CERTAIN	C	4	1.0	0	0.0	4	1.0
		B	36	1.6	0	0.0	36	1.6
	CERTAIN OR PROBABLE	C	14	3.3	0	0.0	14	3.3
		B	62	2.7	2	.1	64	2.8
	CERTAIN PROBABLE OR POSSIBLE	C	17	4.0	1	.2	18	4.3
		B	78	3.5	2	.1	80	3.5
2.1.3.6 OTHER VIEW OBSTRUCTIONS	CERTAIN	C	2	.5	0	0.0	2	.5
		B	9	.4	0	0.0	9	.4
	CERTAIN OR PROBABLE	C	3	.7	0	0.0	3	.7
		B	27	1.2	0	0.0	27	1.2
	CERTAIN PROBABLE OR POSSIBLE	C	6	1.4	0	0.0	6	1.4
		B	40	1.8	0	0.0	40	1.8

DETAILED ENVIRONMENTAL FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
2.1.4 DESIGN PROBLEMS	CERTAIN	C	8	1.9	0	0.0	8	1.9
		B	31	1.4	0	0.0	31	1.4
	CERTAIN OR PROBABLE	C	19	4.5	1	.2	20	4.8
		B	49	2.2	2	.1	51	2.3
	CERTAIN PROBABLE OR POSSIBLE	C	30	7.1	1	.2	31	7.4
		B	65	2.9	5	.2	70	3.1
2.1.4.1 ACCESSES INSUFFICIENTLY LIMITED OR IMPROPERLY PLACED	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	2	.1	0	0.0	2	.1
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	3	.1	0	0.0	3	.1
2.1.4.2 INTERSECTION DESIGN PROBLEMS	CERTAIN	C	1	.2	0	0.0	1	.2
		B	2	.1	0	0.0	2	.1
	CERTAIN OR PROBABLE	C	5	1.2	0	0.0	5	1.2
		B	10	.4	0	0.0	10	.4
	CERTAIN PROBABLE OR POSSIBLE	C	7	1.7	0	0.0	7	1.7
		B	16	.7	0	0.0	16	.7
2.1.4.3 ROAD OVERLY NARROW, TWISTING, ETC.	CERTAIN	C	7	1.7	0	0.0	7	1.7
		B	17	.8	0	0.0	17	.8
	CERTAIN OR PROBABLE	C	12	2.9	0	0.0	12	2.9
		B	24	1.1	0	0.0	24	1.1
	CERTAIN PROBABLE OR POSSIBLE	C	16	3.8	0	0.0	16	3.8
		B	32	1.4	2	.1	34	1.5

DETAILED ENVIRONMENTAL FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
2.1.4.4 TREES AND OTHER OBJECTS TOO CLOSE TO ROAD	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.1	0	0.0	2	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	3	.1	1	.0	4	.2
	CERTAIN PROBABLE OR POSSIBLE	C	2	.5	0	0.0	2	.5
		B	3	.1	1	.0	4	.2
2.1.4.5 OTHER DESIGN PROBLEMS	CERTAIN	C	0	0.0	1	.2	1	.2
		B	9	.4	0	0.0	9	.4
	CERTAIN OR PROBABLE	C	2	.5	2	.5	4	1.0
		B	11	.5	1	.0	12	.5
	CERTAIN PROBABLE OR POSSIBLE	C	4	1.0	2	.5	6	1.4
		B	12	.5	2	.1	14	.6
2.1.5 MAINTENANCE PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	3	.1	2	.1	5	.2
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	5	.2	3	.1	8	.4
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	7	.3	3	.1	10	.4
2.1.5.1 SIGNALS INOPERATIVE	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0

DETAILED ENVIRONMENTAL FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL O/O	S/I N	S/I O/O	CAUSAL OR S/I N	CAUSAL OR S/I O/O
2.1.5.2 TRAFFIC CONTROL SIGN MISSING	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
2.1.5.3 TRAFFIC CONTROL SIGN OR SIGNAL OBSCURED	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	1	.0	1	.0
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	2	.1	1	.0	3	.1
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	4	.2	1	.0	5	.2
2.1.5.4 OTHER PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.1	1	.0	3	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	2	.1	2	.1	4	.2
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	2	.1	2	.1	4	.2
2.2 AMBIENCE RELATED	CERTAIN	C	10	2.4	0	0.0	10	2.4
		B	98	4.3	0	0.0	98	4.3
	CERTAIN OR PROBABLE	C	29	6.9	0	0.0	29	6.9
		B	169	7.5	2	.1	171	7.6
	CERTAIN PROBABLE OR POSSIBLE	C	55	13.1	0	0.0	55	13.1
		B	244	10.8	2	.1	246	10.9

DETAILED ENVIRONMENTAL FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
2.2.1 SPECIAL HAZARDS	CERTAIN	C	8	1.9	0	0.0	8	1.9
		B	76	3.4	0	0.0	76	3.4
	CERTAIN OR PROBABLE	C	22	5.2	0	0.0	22	5.2
		B	123	5.4	0	0.0	123	5.4
	CERTAIN PROBABLE OR POSSIBLE	C	36	8.6	0	0.0	36	8.6
		B	151	6.7	0	0.0	151	6.7
2.2.1.1 ANIMAL IN ROAD	CERTAIN	C	1	.2	0	0.0	1	.2
		B	7	.3	0	0.0	7	.3
	CERTAIN OR PROBABLE	C	3	.7	0	0.0	3	.7
		B	13	.6	0	0.0	13	.6
	CERTAIN PROBABLE OR POSSIBLE	C	4	1.0	0	0.0	4	1.0
		B	13	.6	0	0.0	13	.6
2.2.1.2 OBJECT IN ROAD	CERTAIN	C	1	.2	0	0.0	1	.2
		B	4	.2	0	0.0	4	.2
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	5	.2	0	0.0	5	.2
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	5	.2	0	0.0	5	.2
2.2.1.3 NON-CONTACT VEHICLE CAUSED PROBLEM	CERTAIN	C	4	1.0	0	0.0	4	1.0
		B	49	2.2	0	0.0	49	2.2
	CERTAIN OR PROBABLE	C	16	3.8	0	0.0	16	3.8
		B	85	3.8	0	0.0	85	3.8
	CERTAIN PROBABLE OR POSSIBLE	C	29	6.9	0	0.0	29	6.9
		B	112	5.0	0	0.0	112	5.0

DETAILED ENVIRONMENTAL FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
2.2.1.4 STOPPED VEHICLE IN ROAD	CERTAIN	C	2	.5	0	0.0	2	.5
		B	7	.3	0	0.0	7	.3
	CERTAIN OR PROBABLE	C	2	.5	0	0.0	2	.5
		B	8	.4	0	0.0	8	.4
	CERTAIN PROBABLE OR POSSIBLE	C	2	.5	0	0.0	2	.5
		B	8	.4	0	0.0	8	.4
2.2.1.5 OTHER	CERTAIN	C	1	.2	0	0.0	1	.2
		B	11	.5	0	0.0	11	.5
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	14	.6	0	0.0	14	.6
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	15	.7	0	0.0	15	.7
2.2.2 VISION LIMITATION	CERTAIN	C	2	.5	0	0.0	2	.5
		B	11	.5	0	0.0	11	.5
	CERTAIN OR PROBABLE	C	3	.7	0	0.0	3	.7
		B	26	1.2	0	0.0	26	1.2
	CERTAIN PROBABLE OR POSSIBLE	C	10	2.4	0	0.0	10	2.4
		B	54	2.4	1	.0	55	2.4
2.2.2.1 RAIN	CERTAIN	C	1	.2	0	0.0	1	.2
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	1	.0	0	0.0	1	.0
	CERTAIN PROBABLE OR POSSIBLE	C	2	.5	0	0.0	2	.5
		B	8	.4	0	0.0	8	.4

DETAILED ENVIRONMENTAL FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
2.2.2.2 SNOW	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	0	0.0	0	0.0	0	0.0
2.2.2.3 FOG	CERTAIN	C	1	.2	0	0.0	1	.2
		B	2	.1	0	0.0	2	.1
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	5	.2	0	0.0	5	.2
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	7	.3	0	0.0	7	.3
2.2.2.4 DARKNESS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.1	0	0.0	2	.1
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	7	.3	0	0.0	7	.3
	CERTAIN PROBABLE OR POSSIBLE	C	2	.5	0	0.0	2	.5
		B	14	.6	0	0.0	14	.6
2.2.2.5 GLARE FROM SUN	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	6	.3	0	0.0	6	.3
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	12	.5	0	0.0	12	.5
	CERTAIN PROBABLE OR POSSIBLE	C	3	.7	0	0.0	3	.7
		B	21	.9	1	.0	22	1.0

DETAILED ENVIRONMENTAL FACTORS SUMMARY BY ACCIDENT FOR PHASES II, III, IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
2.2.2.6 GLARE FROM HEADLIGHTS	CERTAIN	C	1	.2	0	0.0	1	.2
		B	1	.0	0	0.0	1	.0
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	1	.0	0	0.0	1	.0
	CERTAIN PROBABLE OR POSSIBLE	C	3	.7	0	0.0	3	.7
		B	6	.3	0	0.0	6	.3
2.2.2.7 OTHER	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
2.2.3 AVOIDANCE OBSTRUCTIONS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	8	.4	0	0.0	8	.4
	CERTAIN OR PROBABLE	C	3	.7	0	0.0	3	.7
		B	17	.8	2	.1	19	.8
	CERTAIN PROBABLE OR POSSIBLE	C	5	1.2	0	0.0	5	1.2
		B	23	1.0	2	.1	25	1.1
2.2.3.1 PARKED OR STOPPED TRAFFIC	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	4	.2	0	0.0	4	.2
	CERTAIN OR PROBABLE	C	2	.5	0	0.0	2	.5
		B	9	.4	0	0.0	9	.4
	CERTAIN PROBABLE OR POSSIBLE	C	2	.5	0	0.0	2	.5
		B	15	.7	0	0.0	15	.7

DETAILED ENVIRONMENTAL FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
2.2.3.2 TREES AND OTHER FIXED OBJECTS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.1	0	0.0	2	.1
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	4	.2	1	.0	5	.2
	CERTAIN PROBABLE OR POSSIBLE	C	3	.7	0	0.0	3	.7
		B	4	.2	1	.0	5	.2
2.2.3.3 OTHER	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.1	0	0.0	2	.1
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	4	.2	1	.0	5	.2
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	4	.2	1	.0	5	.2
2.2.4 RAPID WEATHER CHANGE	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
2.2.4.1 SUDDENLY ENCOUNTERED FOG	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0

DETAILED ENVIRONMENTAL FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
2.2.4.2 SUDDENLY ENCOUNTERED SLICK ROADS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
2.2.4.3 OTHER	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
2.2.5 CAMOUFLAGE EFFECT	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.0	1	.0	2	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	2	.1	1	.0	3	.1
	CERTAIN PROBABLE OR POSSIBLE	C	4	1.0	0	0.0	4	1.0
		B	10	.4	1	.0	11	.5
2.2.5.1 MOTOR VEHICLE BLENDED IN WITH BACKGROUND	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	2	.1	0	0.0	2	.1
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	9	.4	0	0.0	9	.4

DETAILED ENVIRONMENTAL FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL O/O	S/I N	S/I O/O	CAUSAL OR S/I N	CAUSAL OR S/I O/O
2.2.5.2 OTHER	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	1	.0	1	.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	1	.0	1	.0
	CERTAIN PROBABLE OR POSSIBLE	C	3	.7	0	0.0	3	.7
		B	1	.0	1	.0	2	.1
2.2.6 ENVIRONMENTAL OVERLOAD	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	5	.2	0	0.0	5	.2
2.2.7 OTHER AMBIENCE RELATED FACTORS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.1	0	0.0	2	.1
	CERTAIN OR PROBABLE	C	2	.5	0	0.0	2	.5
		B	4	.2	0	0.0	4	.2
	CERTAIN PROBABLE OR POSSIBLE	C	5	1.2	1	.2	6	1.4
		B	13	.6	0	0.0	13	.6

DETAILED VEHICLE FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
I. VEHICLE FACTORS	CERTAIN	C	19	4.5	3	.7	22	5.2
		B	92	4.1	12	.5	104	4.6
	CERTAIN OR PROBABLE	C	48	11.4	5	1.2	53	12.6
		B	179	7.9	26	1.2	205	9.1
	CERTAIN PROBABLE OR POSSIBLE	C	101	24.0	5	1.2	106	25.2
		B	281	12.4	52	2.3	333	14.7
1.0 TIRES AND WHEELS	CERTAIN	C	2	.5	3	.7	5	1.2
		B	11	.5	5	.2	16	.7
	CERTAIN OR PROBABLE	C	13	3.1	4	1.0	17	4.0
		B	39	1.7	12	.5	51	2.3
	CERTAIN PROBABLE OR POSSIBLE	C	32	7.6	5	1.2	37	8.8
		B	59	2.6	26	1.2	85	3.8
1.1 INFLATION	CERTAIN	C	0	0.0	2	.5	2	.5
		B	2	.1	1	.0	3	.1
	CERTAIN OR PROBABLE	C	5	1.2	2	.5	7	1.7
		B	5	.2	2	.1	7	.3
	CERTAIN PROBABLE OR POSSIBLE	C	17	4.0	2	.5	19	4.5
		B	7	.3	2	.1	9	.4
1.1.1 UNDERINFLATION	CERTAIN	C	0	0.0	1	.2	1	.2
		B	2	.1	1	.0	3	.1
	CERTAIN OR PROBABLE	C	5	1.2	1	.2	6	1.4
		B	4	.2	2	.1	6	.3
	CERTAIN PROBABLE OR POSSIBLE	C	14	3.3	1	.2	15	3.6
		B	6	.3	2	.1	8	.4

DETAILED VEHICLE FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
1.1.2 OVERINFLATION	CERTAIN	C	0	0.0	1	.2	1	.2
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	1	.2	1	.2
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	3	.7	1	.2	4	1.0
		B	0	0.0	0	0.0	0	0.0
1.1.3 IMPROPER PRESSURE DISTRIBUTION	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	1	.0	0	0.0	1	.0
1.2 INADEQUATE TREAD DEPTH	CERTAIN	C	1	.2	2	.5	3	.7
		B	6	.3	4	.2	10	.4
	CERTAIN OR PROBABLE	C	8	1.9	3	.7	11	2.6
		B	29	1.3	10	.4	39	1.7
	CERTAIN PROBABLE OR POSSIBLE	C	13	3.1	5	1.2	18	4.3
		B	44	1.9	23	1.0	67	3.0
1.3 BLOW-OUT/ SUDDEN FAILURE	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	2	.1	0	0.0	2	.1
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	3	.1	0	0.0	3	.1

DETAILED VEHICLE FACTORS SUMMARY BY ACCIDENT, FOR PHASES II, III, IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
1.4 MISMATCH OF TIRE TYPE AND/OR SIZES	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	2	.5	0	0.0	2	.5
		B	2	.1	1	.0	3	.1
1.5 WHEEL LOSS OR FAILURE	CERTAIN	C	1	.2	0	0.0	1	.2
		B	1	.0	0	0.0	1	.0
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	1	.0	0	0.0	1	.0
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	1	.0	0	0.0	1	.0
1.6 OTHER TIRE OR WHEEL PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.1	1	.0	3	.1
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	4	.2	1	.0	5	.2
	CERTAIN PROBABLE OR POSSIBLE	C	4	1.0	0	0.0	4	1.0
		B	6	.3	1	.0	7	.3
2.0 BRAKE SYSTEM	CERTAIN	C	12	2.9	1	.2	13	3.1
		B	40	1.8	1	.0	41	1.8
	CERTAIN OR PROBABLE	C	20	4.8	2	.5	22	5.2
		B	58	2.6	6	.3	64	2.8
	CERTAIN PROBABLE OR POSSIBLE	C	30	7.1	2	.5	32	7.6
		B	87	3.9	17	.8	104	4.6

DETAILED VEHICLE FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL		S/I		CAUSAL OR S/I	
			N	0/0	N	0/0	N	0/0
2.1 GROSS FAILURE (FRONT AND/OR REAR)	CERTAIN	C	8	1.9	1	.2	9	2.1
		B	34	1.5	1	.0	35	1.6
	CERTAIN OR PROBABLE	C	11	2.6	2	.5	13	3.1
		B	39	1.7	4	.2	43	1.9
	CERTAIN PROBABLE OR POSSIBLE	C	13	3.1	2	.5	15	3.6
		B	49	2.2	9	.4	58	2.6
2.1.1 WHEEL CYLINDER FAILED	CERTAIN	C	2	.5	0	0.0	2	.5
		B	5	.2	0	0.0	5	.2
	CERTAIN OR PROBABLE	C	2	.5	1	.2	3	.7
		B	5	.2	1	.0	6	.3
	CERTAIN PROBABLE OR POSSIBLE	C	2	.5	1	.2	3	.7
		B	6	.3	3	.1	9	.4
2.1.2 BRAKE LINE FAILED	CERTAIN	C	3	.7	0	0.0	3	.7
		B	9	.4	0	0.0	9	.4
	CERTAIN OR PROBABLE	C	3	.7	0	0.0	3	.7
		B	9	.4	0	0.0	9	.4
	CERTAIN PROBABLE OR POSSIBLE	C	4	1.0	0	0.0	4	1.0
		B	9	.4	0	0.0	9	.4
2.1.3 MASTER CYLINDER PROBLEM	CERTAIN	C	1	.2	0	0.0	1	.2
		B	2	.1	0	0.0	2	.1
	CERTAIN OR PROBABLE	C	2	.5	0	0.0	2	0.5
		B	2	.1	0	0.0	2	.1
	CERTAIN PROBABLE OR POSSIBLE	C	2	.5	0	0.0	2	.5
		B	2	.1	0	0.0	2	.1

DETAILED VEHICLE FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
2.1.4 INSUFFICIENT FLUID LEVEL	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	3	.1	1	.0	4	.2
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	3	.1	1	.0	4	.2
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	3	.1	1	.0	4	.2
2.1.5 ADJUSTMENT MECHANISM LOSS OR FAILURE	CERTAIN	C	1	.2	0	0.0	1	.2
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	2	.5	0	0.0	2	.5
		B	0	0.0	1	.0	1	.0
	CERTAIN PROBABLE OR POSSIBLE	C	2	.5	0	0.0	2	.5
		B	2	.1	1	.0	3	.1
2.1.6 GROSS FAILURE-OTHER OR UNSPECIFIED	CERTAIN	C	2	.5	1	.2	3	.7
		B	16	.7	0	0.0	16	.7
	CERTAIN OR PROBABLE	C	5	1.2	1	.2	6	1.4
		B	21	.9	1	.0	22	1.0
	CERTAIN PROBABLE OR POSSIBLE	C	6	1.4	1	.2	7	1.7
		B	28	1.2	4	.2	32	1.4
2.2 DELAYED BRAKING RESPONSE--PUMPING REQUIRED	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.1	0	0.0	2	.1
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	7	.3	2	.1	9	.4
	CERTAIN PROBABLE OR POSSIBLE	C	2	.5	0	0.0	2	.5
		B	11	.5	4	.2	15	.7

DETAILED VEHICLE FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
2.2.1 REQUIRED PUMPING DUE TO IMPROPER ADJUSTMENT	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.1	0	0.0	2	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	6	.3	1	.0	7	.3
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	7	.3	1	.0	8	.4
2.2.2 REQUIRED PUMPING FOR OTHER REASONS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	1	.0	1	.0	2	.1
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	4	.2	3	.1	7	.3
2.3 IMBALANCE (PULLED LEFT OR RIGHT)	CERTAIN	C	4	1.0	0	0.0	4	1.0
		B	1	.0	0	0.0	1	.0
	CERTAIN OR PROBABLE	C	8	1.9	0	0.0	8	1.9
		B	7	.3	0	0.0	7	.3
	CERTAIN PROBABLE OR POSSIBLE	C	11	2.6	0	0.0	11	2.6
		B	14	.6	1	.0	15	.7
2.4 BRAKES GRABBED, LOCKED PREMATURELY, OR WERE OVERSENSITIVE	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	2	.1	0	0.0	2	.1
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	4	.2	0	0.0	4	.2

DETAILED VEHICLE FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
2.4.1 DUE TO IMPROPER PROPORTIONING	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
2.4.2 GRABBED OR LOCKED PREMATURELY	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	3	.1	0	0.0	3	.1
2.5 PERFORMANCE DEGRADED FOR OTHER REASONS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.1	0	0.0	2	.1
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	3	.1	0	0.0	3	.1
	CERTAIN PROBABLE OR POSSIBLE	C	5	1.2	0	0.0	5	1.2
		B	9	.4	3	.1	12	.5
3.0 STEERING SYSTEM	CERTAIN	C	1	.2	0	0.0	1	.2
		B	3	.1	4	.2	7	.3
	CERTAIN OR PROBABLE	C	4	1.0	0	0.0	4	1.0
		B	15	.7	10	.4	25	1.1
	CERTAIN PROBABLE OR POSSIBLE	C	15	3.6	0	0.0	15	3.6
		B	31	1.4	16	.7	47	2.1

DETAILED VEHICLE FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
3.1 EXCESSIVE FREEPLAY	CERTAIN	C	1	.2	0	0.0	1	.2
		B	1	.0	4	.2	5	.2
	CERTAIN OR PROBABLE	C	3	.7	0	0.0	3	.7
		B	9	.4	10	.4	19	.8
	CERTAIN PROBABLE OR POSSIBLE	C	10	2.4	0	0.0	10	2.4
		B	21	.9	16	.7	37	1.6
3.2 BINDING (UNDUE EFFORT REQUIRED)	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	1	.0	0	0.0	1	.0
3.3 FREEZING OR LOCKING	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	3	.1	0	0.0	3	.1
3.4 OTHER STEERING PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.1	0	0.0	2	.1
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	5	.2	0	0.0	5	.2
	CERTAIN PROBABLE OR POSSIBLE	C	5	1.2	0	0.0	5	1.2
		B	6	.3	0	0.0	6	.3

DETAILED VEHICLE FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL O/O	S/I N	S/I O/O	CAUSAL OR S/I N	CAUSAL OR S/I O/O
4.0 SUSPENSION PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	4	.2	1	.0	5	.2
	CERTAIN PROBABLE OR POSSIBLE	C	6	1.4	0	0.0	6	1.4
		B	7	.3	4	.2	11	.5
4.1 SHOCK ABSORBER PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	4	.2	0	0.0	4	.2
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	6	.3	1	.0	7	.3
4.1.1 WEAK SHOCK ABSORBERS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	4	.2	0	0.0	4	.2
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	6	.3	1	.0	7	.3
4.1.2 MISSING, BROKEN, OR OTHER SHOCK ABSORBER PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	0	0.0	0	0.0	0	0.0

DETAILED VEHICLE FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
4.2 SPRING PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	2	.5	0	0.0	2	.5
		B	1	.0	2	.1	3	.1
4.2.1 MISSING, BROKEN, OR DEFECTIVE SPRINGS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	1	.0	1	.0
4.2.2 RAISED REAR END	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	2	.5	0	0.0	2	.5
		B	1	.0	1	.0	2	.1
4.2.3 SPRING IMBALANCES (DUE TO HELPER, ETC.)	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0

DETAILED VEHICLE FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
4.3 OTHER SUSPENSION PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	0	0.0	1	.0	1	.0
	CERTAIN PROBABLE OR POSSIBLE	C	3	.7	0	0.0	3	.7
		B	0	0.0	2	.1	2	.1
5.0 POWER TRAIN AND EXHAUST	CERTAIN	C	1	.2	0	0.0	1	.2
		B	3	.1	0	0.0	3	.1
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	8	.4	0	0.0	8	.4
	CERTAIN PROBABLE OR POSSIBLE	C	4	1.0	0	0.0	4	1.0
		B	11	.5	0	0.0	11	.5
5.1 POWER LOSS	CERTAIN	C	1	.2	0	0.0	1	.2
		B	3	.1	0	0.0	3	.1
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	8	.4	0	0.0	8	.4
	CERTAIN PROBABLE OR POSSIBLE	C	2	.5	0	0.0	2	.5
		B	11	.5	0	0.0	11	.5
5.1.1 RAN OUT OF FUEL	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0

DETAILED VEHICLE FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL O/O	S/I N	S/I O/O	CAUSAL OR S/I N	CAUSAL OR S/I O/O
5.1.2 OTHER PROBLEMS	CERTAIN	C	1	.2	0	0.0	1	.2
		B	3	.1	0	0.0	3	.1
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	7	.3	0	0.0	7	.3
	CERTAIN PROBABLE OR POSSIBLE	C	2	.5	0	0.0	2	.5
		B	10	.4	0	0.0	10	.4
5.2 EXHAUST SYSTEM	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	2	.5	0	0.0	2	.5
		B	0	0.0	0	0.0	0	0.0
5.2.1 CARBON MONOXIDE LEAKED INTO DRIVERS COMPARTMENT	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	2	.5	0	0.0	2	.5
		B	0	0.0	0	0.0	0	0.0
5.2.2 OTHER PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0

DETAILED VEHICLE FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
6.0 COMMUNICATION SYSTEMS	CERTAIN	C	1	.2	0	0.0	1	.2
		B	22	1.0	0	0.0	22	1.0
	CERTAIN OR PROBABLE	C	7	1.7	0	0.0	7	1.7
		B	48	2.1	1	.0	49	2.2
	CERTAIN PROBABLE OR POSSIBLE	C	22	5.2	0	0.0	22	5.2
		B	74	3.3	4	.2	78	3.5
6.1 VEHICLE LIGHTS AND SIGNALS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	7	.3	0	0.0	7	.3
	CERTAIN OR PROBABLE	C	3	.7	0	0.0	3	.7
		B	13	.6	1	.0	14	.6
	CERTAIN PROBABLE OR POSSIBLE	C	13	3.1	0	0.0	13	3.1
		B	21	.9	2	.1	23	1.0
6.1.1 HEADLAMP PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	0	0.0	0	0.0	0	0.0
6.1.1.1 INOPERABLE HEADLAMP	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	0	0.0	0	0.0	0	0.0

DETAILED VEHICLE FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL O/O	S/I N	S/I O/O	CAUSAL OR S/I N	CAUSAL OR S/I O/O
6.1.1.2 MISAIMED HEADLAMPS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	0	0.0	0	0.0	0	0.0
6.1.1.3 DIRT-OBSCURED HEADLAMPS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
6.1.2 INOPERABLE TAILLIGHTS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	5	.2	0	0.0	5	.2
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	7	.3	0	0.0	7	.3
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	9	.4	0	0.0	9	.4
6.1.3 INOPERABLE TURN SIGNALS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	3	.1	0	0.0	3	.1
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	6	.3	1	.0	7	.3
	CERTAIN PROBABLE OR POSSIBLE	C	3	.7	0	0.0	3	.7
		B	9	.4	1	.0	10	.4

DETAILED VEHICLE FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
6.1.4 INOPERABLE STOP LIGHTS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN OR PROBABLE	C	2	.5	0	0.0	2	.5
		B	1	.0	0	0.0	1	.0
	CERTAIN PROBABLE OR POSSIBLE	C	4	1.0	0	0.0	4	1.0
		B	2	.1	0	0.0	2	.1
6.1.5 REAR LIGHTS/ SIGNALS OBSCURED BY DIRT, ROAD GRIME, ETC.	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	2	.1	0	0.0	2	.1
6.1.6 OTHER LIGHT PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN PROBABLE OR POSSIBLE	C	5	1.2	0	0.0	5	1.2
		B	3	.1	1	.0	4	.2
6.2 VEHICLE-RELATED VISION OBSTRUCTIONS	CERTAIN	C	1	.2	0	0.0	1	.2
		B	15	.7	0	0.0	15	.7
	CERTAIN OR PROBABLE	C	4	1.0	0	0.0	4	1.0
		B	36	1.6	0	0.0	36	1.6
	CERTAIN PROBABLE OR POSSIBLE	C	9	2.1	0	0.0	9	2.1
		B	51	2.3	3	.1	54	2.4

DETAILED VEHICLE FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
6.2.1 DUE TO ICE, SNOW, FROST, WATER OR CONDENSATION ON WINDOWS	CERTAIN	C	1	.2	0	0.0	1	.2
		B	9	.4	0	0.0	9	.4
	CERTAIN OR PROBABLE	C	2	.5	0	0.0	2	.5
		B	22	1.0	0	0.0	22	1.0
	CERTAIN PROBABLE OR POSSIBLE	C	4	1.0	0	0.0	4	1.0
		B	26	1.2	2	.1	28	1.2
6.2.2 DUE TO CRACKED OR OPAQUE WINDOWS (E.G., CARDBOARD OR DECALS)	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	2	.1	0	0.0	2	.1
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	2	.1	0	0.0	2	.1
6.2.3 DUE TO DESIGN OR PLACEMENT OF WINDOWS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	5	.2	0	0.0	5	.2
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	5	.2	0	0.0	5	.2
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	6	.3	0	0.0	6	.3
6.2.4 DUE TO OBJECTS IN OR ATTACHED TO VEHICLE	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	2	.1	0	0.0	2	.1
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	6	.3	0	0.0	6	.3

DETAILED VEHICLE FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL O/O	S/I N	S/I O/O	CAUSAL OR S/I N	CAUSAL OR S/I O/O
6.2.5 DUE TO INOPERABLE OR DEFICIENT VISION HARDWARE	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	6	.3	0	0.0	6	.3
	CERTAIN PROBABLE OR POSSIBLE	C	4	1.0	0	0.0	4	1.0
		B	12	.5	1	.0	13	.6
6.2.5.1 INOPERABLE OR MISAIMED WINDSHIELD WASHER	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
6.2.5.2 INOPERABLE OR INEFFECTIVE WIPER	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
6.2.5.3 INOPERABLE OR INADEQUATE DEFROSTER	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	2	.1	0	0.0	2	.1
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	2	.1	0	0.0	2	.1

DETAILED VEHICLE FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
6.2.5.4 ABSENCE OR CONDITION OF MIRRORS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	2	.5	0	0.0	2	.5
		B	1	.0	0	0.0	1	.0
6.2.5.5 OTHER PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	4	.2	0	0.0	4	.2
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	8	.4	1	.0	9	.4
6.3 AUDITORY PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	3	.1	0	0.0	3	.1
6.3.1 INOPERABLE OR WEAK HORN	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	3	.1	0	0.0	3	.1

DETAILED VEHICLE FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
6.3.2 EXCESSIVE RADIO OR TAPE PLAYER VOLUME INSIDE CAR	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
6.3.3 OTHER PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
7.0 DRIVER SEATING AND CONTROLS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	3	.1	0	0.0	3	.1
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	3	.1	0	0.0	3	.1
	CERTAIN PROBABLE OR POSSIBLE	C	3	.7	0	0.0	3	.7
		B	11	.5	0	0.0	11	.5
7.1 DRIVER CONTROLS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	3	.1	0	0.0	3	.1
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	3	.1	0	0.0	3	.1
	CERTAIN PROBABLE OR POSSIBLE	C	3	.7	0	0.0	3	.7
		B	10	.4	0	0.0	10	.4

DETAILED VEHICLE FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
7.1.1 STEERING WHEEL PROBLEMS (E.G., SPINNER SNAGGED CLOTHING)	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	2	.1	0	0.0	2	.1
7.1.2 BRAKE PEDAL PROBLEM (E.G., PEDAL BROKE OFF)	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
7.1.3 ACCELERATOR PROBLEM (E.G., STUCK)	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.1	0	0.0	2	.1
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	2	.1	0	0.0	2	.1
	CERTAIN PROBABLE OR POSSIBLE	C	2	.5	0	0.0	2	.5
		B	5	.2	0	0.0	5	.2
7.1.4 OTHER PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	2	.1	0	0.0	2	.1

DETAILED VEHICLE FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
7.2 DRIVER ANTHROPOMETRIC	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
7.2.1 SEAT LOOSE OR BECAME DETACHED	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
7.2.2 DRIVER NOT POSITIONED TO ADEQUATELY REACH CONTROLS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
7.2.3 DRIVER NOT POSITIONED TO SEE ADEQUATELY	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0

DETAILED VEHICLE FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
7.2.4 OTHER PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
8.0 BODY AND DOORS	CERTAIN	C	2	.5	0	0.0	2	.5
		B	2	.1	0	0.0	2	.1
	CERTAIN OR PROBABLE	C	3	.7	0	0.0	3	.7
		B	2	.1	0	0.0	2	.1
	CERTAIN PROBABLE OR POSSIBLE	C	3	.7	0	0.0	3	.7
		B	5	.2	0	0.0	5	.2
8.1 DOOR CAME OPEN	CERTAIN	C	1	.2	0	0.0	1	.2
		B	1	.0	0	0.0	1	.0
	CERTAIN OR PROBABLE	C	2	.5	0	0.0	2	.5
		B	1	.0	0	0.0	1	.0
	CERTAIN PROBABLE OR POSSIBLE	C	2	.5	0	0.0	2	.5
		B	3	.1	0	0.0	3	.1
8.2 HOOD CAME OPEN	CERTAIN	C	1	.2	0	0.0	1	.2
		B	1	.0	0	0.0	1	.0
	CERTAIN OR PROBABLE	C	1	.2	0	0.0	1	.2
		B	1	.0	0	0.0	1	.0
	CERTAIN PROBABLE OR POSSIBLE	C	1	.2	0	0.0	1	.2
		B	1	.0	0	0.0	1	.0

DETAILED VEHICLE FACTORS SUMMARY BY ACCIDENT FOR PHASES II,III,IV AND V

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
8.3 OTHER BODY AND DOOR PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.0	0	0.0	1	.0
9.0 OTHER VEHICLE PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	8	.4	2	.1	10	.4
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	11	.5	2	.1	13	.6
	CERTAIN PROBABLE OR POSSIBLE	C	2	.5	0	0.0	2	.5
		B	17	.8	3	.1	20	.9

APPENDIX B: PHASE V CAUSAL RESULT DETAILED DATA TABLES

DETAILED PHASE V HUMAN CAUSATION SUMMARY BY ACCIDENT

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
II. HUMAN FACTORS	CERTAIN	C	52	51.0	0	0.0	52	51.0
		B	455	50.9	0	0.0	455	50.9
	CERTAIN OR PROBABLE	C	86	84.3	0	0.0	86	84.3
		B	786	87.9	2	.2	788	88.1
	CERTAIN PROBABLE OR POSSIBLE	C	96	94.1	1	1.0	97	95.1
		B	845	94.5	2	.2	847	94.7
II. A. DIRECT HUMAN CAUSES	CERTAIN	C	52	51.0	0	0.0	52	51.0
		B	432	48.3	0	0.0	432	48.3
	CERTAIN OR PROBABLE	C	86	84.3	0	0.0	86	84.3
		B	769	86.0	2	.2	771	86.2
	CERTAIN PROBABLE OR POSSIBLE	C	95	93.1	1	1.0	96	94.1
		B	828	92.6	2	.2	830	92.8
1.0 CRITICAL NON-PERFORMANCE	CERTAIN	C	2	2.0	0	0.0	2	2.0
		B	7	.8	0	0.0	7	.8
	CERTAIN OR PROBABLE	C	4	3.9	0	0.0	4	3.9
		B	10	1.1	1	.1	11	1.2
	CERTAIN PROBABLE OR POSSIBLE	C	5	4.9	0	0.0	5	4.9
		B	11	1.2	1	.1	12	1.3
1.1 BLACKOUT	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	2	.2	0	0.0	2	.2
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	4	.4	1	.1	5	.6
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	4	.4	1	.1	5	.6

DETAILED PHASE V HUMAN CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
1.2 FELL ASLEEP/ DOZING	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	5	.6	0	0.0	5	.6
	CERTAIN OR PROBABLE	C	3	2.9	0	0.0	3	2.9
		B	6	.7	0	0.0	6	.7
	CERTAIN PROBABLE OR POSSIBLE	C	4	3.9	0	0.0	4	3.9
		B	7	.8	0	0.0	7	.8
2.0 NON-ACCIDENT (E.G., SUICIDE ATTEMPT)	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
3.0 RECOGNITION ERRORS	CERTAIN	C	32	31.4	0	0.0	32	31.4
		B	221	24.7	0	0.0	221	24.7
	CERTAIN OR PROBABLE	C	49	48.0	0	0.0	49	48.0
		B	428	47.9	1	.1	429	48.0
	CERTAIN PROBABLE OR POSSIBLE	C	58	56.9	0	0.0	58	56.9
		B	474	53.0	1	.1	475	53.1
3.1 DRIVER FAILED TO OBSERVE AND STOP FOR STOP SIGN (SPECIAL TABULATION	CERTAIN	C	5	4.9	0	0.0	5	4.9
		B	33	3.7	0	0.0	33	3.7
	CERTAIN OR PROBABLE	C	5	4.9	0	0.0	5	4.9
		B	40	4.5	0	0.0	40	4.5
	CERTAIN PROBABLE OR POSSIBLE	C	7	6.9	0	0.0	7	6.9
		B	44	4.9	0	0.0	44	4.9

DETAILED PHASE V HUMAN CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
3.2 DELAYS IN RECOGNITION (FOR WHICH REASONS WERE IDENTIFIED)	CERTAIN	C	26	25.5	0	0.0	26	25.5
		B	179	20.0	0	0.0	179	20.0
	CERTAIN OR PROBABLE	C	38	37.3	0	0.0	38	37.3
		B	345	38.6	1	.1	346	38.7
	CERTAIN PROBABLE OR POSSIBLE	C	42	41.2	0	0.0	42	41.2
		B	385	43.1	1	.1	386	43.2
3.2.1 INATTENTION	CERTAIN	C	5	4.9	0	0.0	5	4.9
		B	38	4.3	0	0.0	38	4.3
	CERTAIN OR PROBABLE	C	9	8.8	0	0.0	9	8.8
		B	82	9.2	0	0.0	82	9.2
	CERTAIN PROBABLE OR POSSIBLE	C	15	14.7	0	0.0	15	14.7
		B	97	10.9	0	0.0	97	10.9
3.2.1.1 TO TRAFFIC STOP OR SLOWING AHEAD	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	21	2.3	0	0.0	21	2.3
	CERTAIN OR PROBABLE	C	2	2.0	0	0.0	2	2.0
		B	47	5.3	0	0.0	47	5.3
	CERTAIN PROBABLE OR POSSIBLE	C	2	2.0	0	0.0	2	2.0
		B	50	5.6	0	0.0	50	5.6
3.2.1.2 TO POSITION OF CAR ON ROAD	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	5	.6	0	0.0	5	.6
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	6	.7	0	0.0	6	.7

DETAILED PHASE V HUMAN CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
3.2.1.3 TO ROAD FEATURE (E.G., ONCOMING CURVES, LANE NARROWINGS, ETC.	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
	CERTAIN PROBABLE OR POSSIBLE	C	2	2.0	0	0.0	2	2.0
		B	2	.2	0	0.0	2	.2
3.2.1.4 TO ROAD SIGNS, SIGNALS PROVIDING DRIVER INFORMATION	CERTAIN	C	3	2.9	0	0.0	3	2.9
		B	9	1.0	0	0.0	9	1.0
	CERTAIN OR PROBABLE	C	3	2.9	0	0.0	3	2.9
		B	17	1.9	0	0.0	17	1.9
	CERTAIN PROBABLE OR POSSIBLE	C	5	4.9	0	0.0	5	4.9
		B	21	2.3	0	0.0	21	2.3
3.2.1.5 TO CROSS-FLOWING TRAFFIC	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	4	.4	0	0.0	4	.4
	CERTAIN OR PROBABLE	C	2	2.0	0	0.0	2	2.0
		B	7	.8	0	0.0	7	.8
	CERTAIN PROBABLE OR POSSIBLE	C	2	2.0	0	0.0	2	2.0
		B	14	1.6	0	0.0	14	1.6
3.2.1.6 OTHER	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	2	.2	0	0.0	2	.2
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	4	.4	0	0.0	4	.4
	CERTAIN PROBABLE OR POSSIBLE	C	3	2.9	0	0.0	3	2.9
		B	4	.4	0	0.0	4	.4

DETAILED PHASE V HUMAN CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
3.2.2 INTERNAL DISTRACTIONS	CERTAIN	C	4	3.9	0	0.0	4	3.9
		B	32	3.6	0	0.0	32	3.6
	CERTAIN OR PROBABLE	C	7	6.9	0	0.0	7	6.9
		B	54	6.0	0	0.0	54	6.0
	CERTAIN PROBABLE OR POSSIBLE	C	7	6.9	0	0.0	7	6.9
		B	69	7.7	0	0.0	69	7.7
3.2.2.1 EVENT IN CAR (LOUD NOISE, YELL, SCREAM, ETC.)	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	6	.7	0	0.0	6	.7
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	10	1.1	0	0.0	10	1.1
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	13	1.5	0	0.0	13	1.5
3.2.2.2 ADJUSTING RADIO OR TAPE PLAYER	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	5	.6	0	0.0	5	.6
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	6	.7	0	0.0	6	.7
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	7	.8	0	0.0	7	.8
3.2.2.3 ADJUSTING WINDOWS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0

DETAILED PHASE V HUMAN CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
3.2.2.4 CONVERSATION	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	9	1.0	0	0.0	9	1.0
	CERTAIN OR PROBABLE	C	2	2.0	0	0.0	2	2.0
		B	24	2.7	0	0.0	24	2.7
	CERTAIN PROBABLE OR POSSIBLE	C	2	2.0	0	0.0	2	2.0
		B	31	3.5	0	0.0	31	3.5
3.2.2.5 OTHER	CERTAIN	C	2	2.0	0	0.0	2	2.0
		B	12	1.3	0	0.0	12	1.3
	CERTAIN OR PROBABLE	C	4	3.9	0	0.0	4	3.9
		B	14	1.6	0	0.0	14	1.6
	CERTAIN PROBABLE OR POSSIBLE	C	4	3.9	0	0.0	4	3.9
		B	18	2.0	0	0.0	18	2.0
3.2.3 EXTERNAL DISTRACTION	CERTAIN	C	5	4.9	0	0.0	5	4.9
		B	29	3.2	0	0.0	29	3.2
	CERTAIN OR PROBABLE	C	5	4.9	0	0.0	5	4.9
		B	45	5.0	0	0.0	45	5.0
	CERTAIN PROBABLE OR POSSIBLE	C	7	6.9	0	0.0	7	6.9
		B	55	6.2	0	0.0	55	6.2
3.2.3.1 OTHER TRAFFIC	CERTAIN	C	2	2.0	0	0.0	2	2.0
		B	8	.9	0	0.0	8	.9
	CERTAIN OR PROBABLE	C	2	2.0	0	0.0	2	2.0
		B	10	1.1	0	0.0	10	1.1
	CERTAIN PROBABLE OR POSSIBLE	C	2	2.0	0	0.0	2	2.0
		B	13	1.5	0	0.0	13	1.5

DETAILED PHASE V HUMAN CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
3.2.3.2 DRIVER-SELECTED OUTSIDE ACTIVITY	CERTAIN	C	2	2.0	0	0.0	2	2.0
		B	15	1.7	0	0.0	15	1.7
	CERTAIN OR PROBABLE	C	2	2.0	0	0.0	2	2.0
		B	24	2.7	0	0.0	24	2.7
	CERTAIN PROBABLE OR POSSIBLE	C	2	2.0	0	0.0	2	2.0
		B	27	3.0	0	0.0	27	3.0
3.2.3.3 ACTIVITY OF INTEREST OUTSIDE VEHICLE (FIST FIGHT ETC.)	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	4	.4	0	0.0	4	.4
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	6	.7	0	0.0	6	.7
	CERTAIN PROBABLE OR POSSIBLE	C	2	2.0	0	0.0	2	2.0
		B	7	.8	0	0.0	7	.8
3.2.3.4 SUDDEN EVENT OUTSIDE VEHICLE (EXPLOSION, ETC.)	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
3.2.3.5 OTHER	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	5	.6	0	0.0	5	.6
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	8	.9	0	0.0	8	.9

DETAILED PHASE V HUMAN CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
3.2.4 IMPROPER LOCKOUT	CERTAIN	C	13	12.7	0	0.0	13	12.7
		B	81	9.1	0	0.0	81	9.1
	CERTAIN OR PROBABLE	C	19	18.6	0	0.0	19	18.6
		B	170	19.0	1	.1	171	19.1
	CERTAIN PROBABLE OR POSSIBLE	C	19	18.6	0	0.0	19	18.6
		B	181	20.2	1	.1	182	20.4
3.2.4.1 PULLING OUT FROM PARKING PLACE	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	16	1.8	0	0.0	16	1.8
	CERTAIN OR PROBABLE	C	2	2.0	0	0.0	2	2.0
		B	22	2.5	0	0.0	22	2.5
	CERTAIN PROBABLE OR POSSIBLE	C	2	2.0	0	0.0	2	2.0
		B	23	2.6	0	0.0	23	2.6
3.2.4.2 ENTERING TRAVEL LANE FROM INTERSECTING STREET OR ALLEY	CERTAIN	C	9	8.8	0	0.0	9	8.8
		B	41	4.6	0	0.0	41	4.6
	CERTAIN OR PROBABLE	C	13	12.7	0	0.0	13	12.7
		B	101	11.3	0	0.0	101	11.3
	CERTAIN PROBABLE OR POSSIBLE	C	13	12.7	0	0.0	13	12.7
		B	110	12.3	0	0.0	110	12.3
3.2.4.3 PRIOR TO CHANGING LANES OR PASSING	CERTAIN	C	2	2.0	0	0.0	2	2.0
		B	10	1.1	0	0.0	10	1.1
	CERTAIN OR PROBABLE	C	2	2.0	0	0.0	2	2.0
		B	24	2.7	1	.1	25	2.8
	CERTAIN PROBABLE OR POSSIBLE	C	2	2.0	0	0.0	2	2.0
		B	26	2.9	1	.1	27	3.0

DETAILED PHASE V HUMAN CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
3.2.4.4 OTHER	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	15	1.7	0	0.0	15	1.7
	CERTAIN OR PROBABLE	C	2	2.0	0	0.0	2	2.0
		B	24	2.7	0	0.0	24	2.7
	CERTAIN PROBABLE OR POSSIBLE	C	2	2.0	0	0.0	2	2.0
		B	24	2.7	0	0.0	24	2.7
3.3 DELAYS IN PERCEPTION FOR OTHER OR UNKNOWN REASONS	CERTAIN	C	4	3.9	0	0.0	4	3.9
		B	17	1.9	0	0.0	17	1.9
	CERTAIN OR PROBABLE	C	11	10.8	0	0.0	11	10.8
		B	57	6.4	0	0.0	57	6.4
	CERTAIN PROBABLE OR POSSIBLE	C	17	16.7	1	1.0	18	17.6
		B	75	8.4	0	0.0	75	8.4
3.3.1 OF TRAFFIC STOPPED OR SLOWING AHEAD	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	9	1.0	0	0.0	9	1.0
	CERTAIN OR PROBABLE	C	2	2.0	0	0.0	2	2.0
		B	27	3.0	0	0.0	27	3.0
	CERTAIN PROBABLE OR POSSIBLE	C	3	2.9	1	1.0	4	3.9
		B	35	3.9	0	0.0	35	3.9
3.3.2 OF POSITION OF CAR ON ROAD	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	2	.2	0	0.0	2	.2

DETAILED PHASE V HUMAN CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL O/O	S/I N	S/I O/O	CAUSAL OR S/I N	CAUSAL OR S/I O/O
3.3.3 OF ROAD FEATURES (SUCH AS ONCOMING CURVES, LANE NARROWINGS, ETC	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
	CERTAIN OR PROBABLE	C	2	2.0	0	0.0	2	2.0
		B	7	.8	0	0.0	7	.8
	CERTAIN PROBABLE OR POSSIBLE	C	3	2.9	0	0.0	3	2.9
		B	9	1.0	0	0.0	9	1.0
3.3.4 OF ROAD SIGNS OR SIGNALS PROVIDING DRIVER INFORMATION	CERTAIN	C	2	2.0	0	0.0	2	2.0
		B	3	.3	0	0.0	3	.3
	CERTAIN OR PROBABLE	C	5	4.9	0	0.0	5	4.9
		B	8	.9	0	0.0	8	.9
	CERTAIN PROBABLE OR POSSIBLE	C	7	6.9	0	0.0	7	6.9
		B	13	1.5	0	0.0	13	1.5
3.3.5 OF CROSS-FLOWING TRAFFIC	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	8	.9	0	0.0	8	.9
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	11	1.2	0	0.0	11	1.2
3.3.6 OTHER	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	2	2.0	0	0.0	2	2.0
		B	5	.6	0	0.0	5	.6
	CERTAIN PROBABLE OR POSSIBLE	C	3	2.9	0	0.0	3	2.9
		B	5	.6	0	0.0	5	.6

DETAILED PHASE V HUMAN CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
3.4 UNACCOUNTED FOR DELAYS IN COMPREHENSION OR REACTION	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	9	1.0	1	.1	10	1.1
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	10	1.1	1	.1	11	1.2
3.4.1 DELAYED COMPREHENSION	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	6	.7	0	0.0	6	.7
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	6	.7	0	0.0	6	.7
3.4.2 DELAYED REACTION	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	4	.4	1	.1	5	.6
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	5	.6	1	.1	6	.7
4.0 DECISION ERRORS	CERTAIN	C	16	15.7	0	0.0	16	15.7
		B	172	19.2	1	.1	173	19.4
	CERTAIN OR PROBABLE	C	41	40.2	0	0.0	41	40.2
		B	358	40.0	5	.6	363	40.6
	CERTAIN PROBABLE OR POSSIBLE	C	60	58.8	2	2.0	62	60.8
		B	426	47.7	6	.7	432	48.3

DETAILED PHASE V HUMAN CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
4.1 MISJUDGMENT OF DISTANCE, CLOSURE-RATE, ETC.	CERTAIN	C	3	2.9	0	0.0	3	2.9
		B	7	.8	0	0.0	7	.8
	CERTAIN OR PROBABLE	C	6	5.9	0	0.0	6	5.9
		B	21	2.3	0	0.0	21	2.3
	CERTAIN PROBABLE OR POSSIBLE	C	8	7.8	0	0.0	8	7.8
		B	22	2.5	0	0.0	22	2.5
4.2 FALSE ASSUMPTION	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	55	6.2	0	0.0	55	6.2
	CERTAIN OR PROBABLE	C	2	2.0	0	0.0	2	2.0
		B	93	10.4	0	0.0	93	10.4
	CERTAIN PROBABLE OR POSSIBLE	C	5	4.9	0	0.0	5	4.9
		B	108	12.1	0	0.0	108	12.1
4.2.1 ASSUMED OTHER DRIVER WAS REQUIRED TO STOP OR YIELD AT INTERSECTION	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	9	1.0	0	0.0	9	1.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	16	1.8	0	0.0	16	1.8
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	19	2.1	0	0.0	19	2.1
4.2.2 ASSUMED OTHER DRIVER WOULD STOP/ YIELD WITHOUT AS- SUMING REQUIREMENT	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	9	1.0	0	0.0	9	1.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	16	1.8	0	0.0	16	1.8
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	[illegible]	[illegible]	0	0.0	[illegible]	[illegible]

DETAILED PHASE V HUMAN CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
4.2.3 ASSUMED ON-COMING CAR WOULD MOVE LEFT OR RIGHT, OUT OF WAY	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	3	.3	0	0.0	3	.3
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	4	.4	0	0.0	4	.4
4.2.4 ASSUMED VEHICLE WAS GOING TO TURN AND IT DID NOT	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	10	1.1	0	0.0	10	1.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	11	1.2	0	0.0	11	1.2
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	11	1.2	0	0.0	11	1.2
4.2.5 ASSUMED NO TRAFFIC WAS COMING	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	13	1.5	0	0.0	13	1.5
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	25	2.8	0	0.0	25	2.8
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	25	2.8	0	0.0	25	2.8
4.2.6 OTHER	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	13	1.5	0	0.0	13	1.5
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	24	2.7	0	0.0	24	2.7
	CERTAIN PROBABLE OR POSSIBLE	C	3	2.9	0	0.0	3	2.9
		B	32	3.6	0	0.0	32	3.6

DETAILED PHASE V HUMAN CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
4.3 IMPROPER MANEUVER	CERTAIN	C	3	2.9	0	0.0	3	2.9
		B	45	5.0	1	.1	46	5.1
	CERTAIN OR PROBABLE	C	3	2.9	0	0.0	3	2.9
		B	58	6.5	1	.1	59	6.6
	CERTAIN PROBABLE OR POSSIBLE	C	6	5.9	0	0.0	6	5.9
		B	62	6.9	1	.1	63	7.0
4.3.1 TURN FROM WRONG LANE	CERTAIN	C	2	2.0	0	0.0	2	2.0
		B	23	2.6	0	0.0	23	2.6
	CERTAIN OR PROBABLE	C	2	2.0	0	0.0	2	2.0
		B	26	2.9	0	0.0	26	2.9
	CERTAIN PROBABLE OR POSSIBLE	C	2	2.0	0	0.0	2	2.0
		B	26	2.9	0	0.0	26	2.9
4.3.2 DROVE IN WRONG LANE BUT CORRECT DIRECTION	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	3	.3	0	0.0	3	.3
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	4	.4	0	0.0	4	.4
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	5	.6	0	0.0	5	.6
4.3.3 DROVE IN WRONG DIRECTION OF TRAVEL FOR LANE	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	4	.4	0	0.0	4	.4
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	4	.4	0	0.0	4	.4
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	4	.4	0	0.0	4	.4

DETAILED PHASE V HUMAN CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
4.3.4 PASSED AT IMPROPER LOCATION	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	6	.7	0	0.0	6	.7
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	11	1.2	0	0.0	11	1.2
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	11	1.2	0	0.0	11	1.2
4.3.5 OTHER	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	9	1.0	1	.1	10	1.1
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	13	1.5	1	.1	14	1.6
	CERTAIN PROBABLE OR POSSIBLE	C	4	3.9	0	0.0	4	3.9
		B	16	1.8	1	.1	17	1.9
4.4 IMPROPER DRIVING TECHNIQUE	CERTAIN	C	3	2.9	0	0.0	3	2.9
		B	8	.9	0	0.0	8	.9
	CERTAIN OR PROBABLE	C	6	5.9	0	0.0	6	5.9
		B	21	2.3	1	.1	22	2.5
	CERTAIN PROBABLE OR POSSIBLE	C	13	12.7	0	0.0	13	12.7
		B	32	3.6	1	.1	33	3.7
4.4.1 CRESTING HILLS, DRIVING IN CENTER OF ROAD	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	4	.4	0	0.0	4	.4

DETAILED PHASE V HUMAN CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
4.4.2 BRAKING LATER THAN SHOULD HAVE OR AT INAPPROPRIATE LOCATION	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	3	.3	1	.1	4	.4
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	4	.4	1	.1	5	.6
4.4.3 STOPPING TOO FAR OUT IN ROAD OR INTERSECTION	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
4.4.4 DRIVING TOO CLOSE TO CENTER LINE OR EDGE OF ROAD	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	3	.3	0	0.0	3	.3
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	4	.4	0	0.0	4	.4
4.4.5 SLOWED TOO RAPIDLY	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2

DETAILED PHASE V HUMAN CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
4.4.6 OTHER	CERTAIN	C	3	2.9	0	0.0	3	2.9
		B	6	.7	0	0.0	6	.7
	CERTAIN OR PROBABLE	C	6	5.9	0	0.0	6	5.9
		B	12	1.3	0	0.0	12	1.3
	CERTAIN PROBABLE OR POSSIBLE	C	12	11.8	0	0.0	12	11.8
		B	18	2.0	0	0.0	18	2.0
4.5 DRIVING TECHNIQUE WAS INADEQUATELY DEFENSIVE	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	11	1.2	0	0.0	11	1.2
	CERTAIN OR PROBABLE	C	5	4.9	0	0.0	5	4.9
		B	41	4.6	1	.1	42	4.7
	CERTAIN PROBABLE OR POSSIBLE	C	13	12.7	0	0.0	13	12.7
		B	51	5.7	1	.1	52	5.8
4.5.1 SHOULD HAVE POSITIONED CAR DIFFERENTLY	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	4	.4	0	0.0	4	.4
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	9	1.0	0	0.0	9	1.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	9	1.0	0	0.0	9	1.0
4.5.2 SHOULD HAVE ADJUSTED SPEED	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	2	.2	0	0.0	2	.2
	CERTAIN OR PROBABLE	C	3	2.9	0	0.0	3	2.9
		B	20	2.2	1	.1	21	2.3
	CERTAIN PROBABLE OR POSSIBLE	C	11	10.8	0	0.0	11	10.8
		B	23	2.6	1	.1	24	2.7

DETAILED PHASE V HUMAN CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
4.5.3 SHOULD NOT HAVE TAKEN DRIVERS ADHERENCE-TRAFFIC CONTROL FOR GRANTED	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	3	.3	0	0.0	3	.3
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	6	.7	0	0.0	6	.7
4.5.4 OTHER	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	4	.4	0	0.0	4	.4
	CERTAIN OR PROBABLE	C	2	2.0	0	0.0	2	2.0
		B	9	1.0	0	0.0	9	1.0
	CERTAIN PROBABLE OR POSSIBLE	C	3	2.9	0	0.0	3	2.9
		B	13	1.5	0	0.0	13	1.5
4.6 EXCESSIVE SPEED	CERTAIN	C	6	5.9	0	0.0	6	5.9
		B	35	3.9	0	0.0	35	3.9
	CERTAIN OR PROBABLE	C	14	13.7	0	0.0	14	13.7
		B	111	12.4	2	.2	113	12.6
	CERTAIN PROBABLE OR POSSIBLE	C	18	17.6	0	0.0	18	17.6
		B	139	15.5	5	.6	144	16.1
4.6.1 FOR ROAD DESIGN REGARDLESS OF CONDITION OR TRAFFIC	CERTAIN	C	4	3.9	0	0.0	4	3.9
		B	26	2.9	0	0.0	26	2.9
	CERTAIN OR PROBABLE	C	7	6.9	0	0.0	7	6.9
		B	64	7.2	0	0.0	64	7.2
	CERTAIN PROBABLE OR POSSIBLE	C	10	9.8	0	0.0	10	9.8
		B	71	7.9	1	.1	72	8.1

DETAILED PHASE V HUMAN CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
4.6.2 ONLY IN LIGHT OF TRAFFIC, PEDESTRIANS, ETC.	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	5	.6	1	.1	6	.7
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	11	1.2	1	.1	12	1.3
4.6.3 SOLELY IN LIGHT OF WEATHER CONDITIONS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	4	.4	0	0.0	4	.4
	CERTAIN OR PROBABLE	C	2	2.0	0	0.0	2	2.0
		B	17	1.9	0	0.0	17	1.9
	CERTAIN PROBABLE OR POSSIBLE	C	2	2.0	0	0.0	2	2.0
		B	27	3.0	0	0.0	27	3.0
4.6.4 DUE TO COMBINATIONS OF ABOVE FACTORS	CERTAIN	C	2	2.0	0	0.0	2	2.0
		B	5	.6	0	0.0	5	.6
	CERTAIN OR PROBABLE	C	5	4.9	0	0.0	5	4.9
		B	23	2.6	1	.1	24	2.7
	CERTAIN PROBABLE OR POSSIBLE	C	5	4.9	0	0.0	5	4.9
		B	28	3.1	3	.3	31	3.5
4.6.5 OTHER	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	2	.2	0	0.0	2	.2

DETAILED PHASE V HUMAN CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
4.7 FOLLOWING TOO CLOSELY	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	3	.3	0	0.0	3	.3
	CERTAIN PROBABLE OR POSSIBLE	C	2	2.0	0	0.0	2	2.0
		B	6	.7	0	0.0	6	.7
4.8 INADEQUATE SIGNAL	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	4	.4	0	0.0	4	.4
	CERTAIN PROBABLE OR POSSIBLE	C	3	2.9	0	0.0	3	2.9
		B	12	1.3	0	0.0	12	1.3
4.8.1 FAILURE TO SIGNAL FOR TURN	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	1	.1	0	0.0	1	.1
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	9	1.0	0	0.0	9	1.0
4.8.2 FAILURE TO USE HORN TO WARN	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN PROBABLE OR POSSIBLE	C	2	2.0	0	0.0	2	2.0
		B	1	.1	0	0.0	1	.1

DETAILED PHASE V HUMAN CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
4.8.3 OTHER	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
4.9 FAILURE TO TURN ON HEADLIGHTS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
4.10 EXCESSIVE ACCELERATION (LOSS OF CONTROL)	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	3	.3	0	0.0	3	.3
	CERTAIN OR PROBABLE	C	2	2.0	0	0.0	2	2.0
		B	6	.7	0	0.0	6	.7
	CERTAIN PROBABLE OR POSSIBLE	C	3	2.9	0	0.0	3	2.9
		B	8	.9	0	0.0	8	.9
4.11 PEDESTRIAN RAN INTO TRAFFIC	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0

DETAILED PHASE V HUMAN CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
4.12 IMPROPER EVASIVE ACTION	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	21	2.3	0	0.0	21	2.3
	CERTAIN OR PROBABLE	C	9	8.8	0	0.0	9	8.8
		B	64	7.2	1	.1	65	7.3
	CERTAIN PROBABLE OR POSSIBLE	C	18	17.6	2	2.0	20	19.6
		B	87	9.7	1	.1	88	9.8
4.12.1 DRIVERS EVASIVE STEER WAS INEFFECTIVE DUE TO LOCKED FRONT WHEELS	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	16	1.8	0	0.0	16	1.8
	CERTAIN OR PROBABLE	C	4	3.9	0	0.0	4	3.9
		B	43	4.8	0	0.0	43	4.8
	CERTAIN PROBABLE OR POSSIBLE	C	8	7.8	0	0.0	8	7.8
		B	49	5.5	0	0.0	49	5.5
4.12.2 DRIVER DID NOT ATTEMPT APPROPRIATE EVASIVE STEER	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	3	.3	0	0.0	3	.3
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	10	1.1	0	0.0	10	1.1
	CERTAIN PROBABLE OR POSSIBLE	C	3	2.9	1	1.0	4	3.9
		B	16	1.8	0	0.0	16	1.8
4.12.3 DRIVER COULD HAVE ACCELERATED OUT OF DANGER, BUT DID NOT	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	2	.2	1	.1	3	.3
	CERTAIN PROBABLE OR POSSIBLE	C	2	2.0	0	0.0	2	2.0
		B	11	1.2	1	.1	12	1.3

DETAILED PHASE V HUMAN CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
4.12.4 OTHER	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
	CERTAIN OR PROBABLE	C	4	3.9	0	0.0	4	3.9
		B	9	1.0	0	0.0	9	1.0
	CERTAIN PROBABLE OR POSSIBLE	C	6	5.9	1	1.0	7	6.9
		B	14	1.6	0	0.0	14	1.6
4.13 OTHER DECISION ERRORS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
5.0 PERFORMANCE ERRORS	CERTAIN	C	5	4.9	0	0.0	5	4.9
		B	59	6.6	0	0.0	59	6.6
	CERTAIN OR PROBABLE	C	12	11.8	0	0.0	12	11.8
		B	95	10.6	0	0.0	95	10.6
	CERTAIN PROBABLE OR POSSIBLE	C	16	15.7	1	1.0	17	16.7
		B	110	12.3	2	.2	112	12.5
5.1 OVERCOMPENSATION	CERTAIN	C	3	2.9	0	0.0	3	2.9
		B	13	1.5	0	0.0	13	1.5
	CERTAIN OR PROBABLE	C	9	8.8	0	0.0	9	8.8
		B	27	3.0	0	0.0	27	3.0
	CERTAIN PROBABLE OR POSSIBLE	C	12	11.8	0	0.0	12	11.8
		B	31	3.5	2	.2	33	3.7

DETAILED PHASE V HUMAN CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
5.2 PANIC OR FREEZING	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	4	.4	0	0.0	4	.4
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	11	1.2	0	0.0	11	1.2
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	19	2.1	0	0.0	19	2.1
5.3 INADEQUATE DIRECTIONAL CONTROL	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	42	4.7	0	0.0	42	4.7
	CERTAIN OR PROBABLE	C	2	2.0	0	0.0	2	2.0
		B	60	6.7	0	0.0	60	6.7
	CERTAIN PROBABLE OR POSSIBLE	C	5	4.9	1	1.0	6	5.9
		B	62	6.9	0	0.0	62	6.9
5.3.1 ON CURVE--ALLOWED CAR TO ENTER OPPOSING LANE OF TRAVEL	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	6	.7	0	0.0	6	.7
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	11	1.2	0	0.0	11	1.2
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	11	1.2	0	0.0	11	1.2
5.3.2 ON STRAIGHT--ALLOWED CAR TO ENTER OPPOSING LANE OF TRAVEL	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	3	.3	0	0.0	3	.3
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	4	.4	0	0.0	4	.4
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	5	.6	0	0.0	5	.6

DETAILED PHASE V HUMAN CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
5.3.3 ON STRAIGHT OR CURVE--ALLOWED CAR TO GO OFF RIGHT EDGE OF ROAD	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	25	2.8	0	0.0	25	2.8
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	35	3.9	0	0.0	35	3.9
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	1	1.0	2	2.0
		B	36	4.0	0	0.0	36	4.0
5.3.4 ON STRAIGHT OR CURVE--NOT ABOVE BUT DID NOT STAY IN OWN LANE OF TRAVEL	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	4	.4	0	0.0	4	.4
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	5	.6	0	0.0	5	.6
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	5	.6	0	0.0	5	.6
5.3.5 OTHER	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	4	.4	0	0.0	4	.4
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	5	.6	0	0.0	5	.6
	CERTAIN PROBABLE OR POSSIBLE	C	2	2.0	0	0.0	2	2.0
		B	5	.6	0	0.0	5	.6
5.4 OTHER PERFORMANCE	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	2	.2	0	0.0	2	.2
	CERTAIN OR PROBABLE	C	2	2.0	0	0.0	2	2.0
		B	2	.2	0	0.0	2	.2
	CERTAIN PROBABLE OR POSSIBLE	C	3	2.9	0	0.0	3	2.9
		B	4	.4	0	0.0	4	.4

DETAILED PHASE V HUMAN CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL		S/I		CAUSAL OR S/I	
			N	0/0	N	0/0	N	0/0
6.0 OTHER HUMAN CAUSAL FACTORS	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	2	2.0	0	0.0	2	2.0
		B	2	.2	0	0.0	2	.2
	CERTAIN PROBABLE OR POSSIBLE	C	5	4.9	0	0.0	5	4.9
		B	7	.8	0	0.0	7	.8

DETAILED PHASE V HUMAN CONDITIONS AND STATES SUMMARY BY ACCIDENT

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
II.B. HUMAN CONDITIONS OR STATES	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	36	4.0	0	0.0	36	4.0
	CERTAIN OR PROBABLE	C	7	6.9	0	0.0	7	6.9
		B	107	12.0	1	.1	108	12.1
	CERTAIN PROBABLE OR POSSIBLE	C	30	29.4	0	0.0	30	29.4
		B	171	19.1	2	.2	173	19.4
1.0 PHYSICAL/ PHYSIOLOGICAL	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	29	3.2	0	0.0	29	3.2
	CERTAIN OR PROBABLE	C	4	3.9	0	0.0	4	3.9
		B	71	7.9	0	0.0	71	7.9
	CERTAIN PROBABLE OR POSSIBLE	C	16	15.7	0	0.0	16	15.7
		B	114	12.8	1	.1	115	12.9
1.1 ALCOHOL IMPAIRMENT	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	28	3.1	0	0.0	28	3.1
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	65	7.3	0	0.0	65	7.3
	CERTAIN PROBABLE OR POSSIBLE	C	6	5.9	0	0.0	6	5.9
		B	100	11.2	0	0.0	100	11.2
1.2 OTHER DRUG IMPAIRMENT	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	4	.4	0	0.0	4	.4
	CERTAIN PROBABLE OR POSSIBLE	C	3	2.9	0	0.0	3	2.9
		B	5	.6	0	0.0	5	.6

DETAILED PHASE V HUMAN CONDITIONS AND STATES SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
1.3 FATIGUE	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	2	2.0	0	0.0	2	2.0
		B	3	.3	0	0.0	3	.3
	CERTAIN PROBABLE OR POSSIBLE	C	5	4.9	0	0.0	5	4.9
		B	9	1.0	0	0.0	9	1.0
1.4 PHYSICAL HANDICAP	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	2	2.0	0	0.0	2	2.0
		B	1	.1	0	0.0	1	.1
1.5 REDUCED VISION	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	1	.1	0	0.0	1	.1
	CERTAIN PROBABLE OR POSSIBLE	C	4	3.9	0	0.0	4	3.9
		B	3	.3	1	.1	4	.4
1.6 CHRONIC ILLNESS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1

DETAILED PHASE V HUMAN CONDITIONS AND STATES SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
2.0 MENTAL/ EMOTIONAL	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	15	1.7	0	0.0	15	1.7
	CERTAIN PROBABLE OR POSSIBLE	C	6	5.9	0	0.0	6	5.9
		B	26	2.9	0	0.0	26	2.9
2.1 EMOTIONAL UPSET	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	8	.9	0	0.0	8	.9
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	14	1.6	0	0.0	14	1.6
2.2 PRESSURE FROM OTHER DRIVERS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
2.3 IN-HURRY	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	9	1.0	0	0.0	9	1.0
	CERTAIN PROBABLE OR POSSIBLE	C	5	4.9	0	0.0	5	4.9
		B	13	1.5	0	0.0	13	1.5

DETAILED PHASE V HUMAN CONDITIONS AND STATES SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL O/O	S/I N	S/I O/O	CAUSAL OR S/I N	CAUSAL OR S/I O/O
2.4 MENTAL DEFICIENCY	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
3.0 EXPERIENCE/ EXPOSURE	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	5	.6	0	0.0	5	.6
	CERTAIN OR PROBABLE	C	2	2.0	0	0.0	2	2.0
		B	23	2.6	1	.1	24	2.7
	CERTAIN PROBABLE OR POSSIBLE	C	11	10.8	0	0.0	11	10.8
		B	39	4.4	1	.1	40	4.5
3.1 DRIVER INEXPERIENCE	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	9	1.0	0	0.0	9	1.0
	CERTAIN PROBABLE OR POSSIBLE	C	3	2.9	0	0.0	3	2.9
		B	18	2.0	0	0.0	18	2.0
3.2 VEHICLE UNFAMILIARITY	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	5	.6	0	0.0	5	.6
	CERTAIN PROBABLE OR POSSIBLE	C	3	2.9	0	0.0	3	2.9
		B	7	.8	0	0.0	7	.8

DETAILED PHASE V HUMAN CONDITIONS AND STATES SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
3.3 ROAD OVER-FAMILIARITY	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.[illegible]	0	0.0	0	0.0
		B	0	0.0	1	.1	1	.1
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	0	0.0	1	.1	1	.1
3.4 ROAD/AREA UNFAMILIARITY	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	3	.3	0	0.0	3	.3
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	10	1.1	0	0.0	10	1.1
	CERTAIN PROBABLE OR POSSIBLE	C	5	4.9	0	0.0	5	4.9
		B	16	1.8	0	0.0	16	1.8

DETAILED PHASE V ENVIRONMENTAL CAUSATION SUMMARY BY ACCIDENT

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
III. ENVIRONMENTAL FACTORS-INCLUDING SLICK ROADS	CERTAIN	C	8	7.8	1	1.0	9	8.8
		B	120	13.4	7	.8	127	14.2
	CERTAIN OR PROBABLE	C	28	27.5	3	2.9	31	30.4
		B	248	27.7	14	1.6	262	29.3
	CERTAIN PROBABLE OR POSSIBLE	C	46	45.1	3	2.9	49	48.0
		B	325	36.4	17	1.9	342	38.3
1.0 SLICK ROADS	CERTAIN	C	3	2.9	1	1.0	4	3.9
		B	39	4.4	6	.7	45	5.0
	CERTAIN OR PROBABLE	C	7	6.9	3	2.9	10	9.8
		B	95	10.6	14	1.6	109	12.2
	CERTAIN PROBABLE OR POSSIBLE	C	15	14.7	3	2.9	18	17.6
		B	116	13.0	17	1.9	133	14.9
1.1 ROAD WET	CERTAIN	C	0	0.0	1	1.0	1	1.0
		B	16	1.8	5	.6	21	2.3
	CERTAIN OR PROBABLE	C	3	2.9	4	3.9	7	6.9
		B	56	6.3	13	1.5	69	7.7
	CERTAIN PROBABLE OR POSSIBLE	C	9	8.8	4	3.9	13	12.7
		B	72	8.1	16	1.8	88	9.8
1.2 ROAD SNOW AND/ OR ICE COVERED	CERTAIN	C	3	2.9	0	0.0	3	2.9
		B	17	1.9	0	0.0	17	1.9
	CERTAIN OR PROBABLE	C	3	2.9	0	0.0	3	2.9
		B	26	2.9	0	0.0	26	2.9
	CERTAIN PROBABLE OR POSSIBLE	C	5	4.9	0	0.0	5	4.9
		B	27	3.0	0	0.0	27	3.0

DETAILED PHASE V ENVIRONMENTAL CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
1.3 GRAVEL AND/OR SAND ON PAVEMENT	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	8	.9	0	0.0	8	.9
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	12	1.3	0	0.0	12	1.3
1.4 ROAD SLICK DUE TO TRAFFIC POLISHING	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
1.5 WET AND TRAFFIC POLISHED ASPHALT	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
1.6 GRAVEL ROAD	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.2	1	.1	3	.3
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	2	.2	1	.1	3	.3
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	2	.2	1	.1	3	.3

DETAILED PHASE V ENVIRONMENTAL CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
1.7 OTHER PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	4	.4	0	0.0	4	.4
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	4	.4	0	0.0	4	.4
2.0 ENVIRONMENTAL FACTORS--EXCLUDING 'SLICK ROADS'	CERTAIN	C	5	4.9	0	0.0	5	4.9
		B	85	9.5	2	.2	87	9.7
	CERTAIN OR PROBABLE	C	22	21.6	1	1.0	23	22.5
		B	174	19.5	2	.2	176	19.7
	CERTAIN PROBABLE OR POSSIBLE	C	37	36.3	1	1.0	38	37.3
		B	242	27.1	3	.3	245	27.4
2.1 HIGHWAY RELATED	CERTAIN	C	3	2.9	0	0.0	3	2.9
		B	58	6.5	2	.2	60	6.7
	CERTAIN OR PROBABLE	C	18	17.6	1	1.0	19	18.6
		B	123	13.8	2	.2	125	14.0
	CERTAIN PROBABLE OR POSSIBLE	C	30	29.4	1	1.0	31	30.4
		B	171	19.1	3	.3	174	19.5
2.1.1 CONTROL HINDRANCES	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	6	.7	2	.2	8	.9
	CERTAIN OR PROBABLE	C	6	5.9	0	0.0	6	5.9
		B	14	1.6	2	.2	16	1.8
	CERTAIN PROBABLE OR POSSIBLE	C	8	7.8	0	0.0	8	7.8
		B	23	2.6	3	.3	26	2.9

DETAILED PHASE V ENVIRONMENTAL CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
2.1.1.1 DROP-OFF AT PAVEMENT EDGE	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.2	1	.1	3	.3
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	7	.8	1	.1	8	.9
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	9	1.0	2	.2	11	1.2
2.1.1.2 EXCESSIVE ROAD CROWNS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	1	.1	0	0.0	1	.1
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	2	.2	0	0.0	2	.2
2.1.1.3 IMPROPERLY BANKED CURVES	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	3	.3	0	0.0	3	.3
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	8	.9	0	0.0	8	.9
2.1.1.4 SOFT SHOULDERS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1

DETAILED PHASE V ENVIRONMENTAL CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL O/O	S/I N	S/I O/O	CAUSAL OR S/I N	CAUSAL OR S/I O/O
2.1.1.5 DITCHES EMBANKMENTS, AND OTHER ROADSIDE FEATURES	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	1	.1	2	.2
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	2	.2	1	.1	3	.3
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	3	.3	1	.1	4	.4
2.1.1.6 UNEXPECTED WET OR SLICK SPOTS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	3	2.9	0	0.0	3	2.9
		B	1	.1	0	0.0	1	.1
	CERTAIN PROBABLE OR POSSIBLE	C	3	2.9	0	0.0	3	2.9
		B	1	.1	0	0.0	1	.1
2.1.1.7 OTHER CONTROL HINDRANCES	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	4	3.9	0	0.0	4	3.9
		B	0	0.0	0	0.0	0	0.0
2.1.2 INADEQUATE SIGNS AND SIGNALS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	5	.6	0	0.0	5	.6
	CERTAIN OR PROBABLE	C	2	2.0	0	0.0	2	2.0
		B	19	2.1	0	0.0	19	2.1
	CERTAIN PROBABLE OR POSSIBLE	C	4	3.9	0	0.0	4	3.9
		B	30	3.4	0	0.0	30	3.4

DETAILED PHASE V ENVIRONMENTAL CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
2.1.2.1 STOP SIGN NEEDED BUT NOT PROVIDED	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	4	.4	0	0.0	4	.4
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	5	.6	0	0.0	5	.6
2.1.2.2 STOP SIGN PRESENT BUT NOT ADEQUATE	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
2.1.2.3 CURVE WARNING SIGNS NEEDED	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	5	.6	0	0.0	5	.6
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	8	.9	0	0.0	8	.9
2.1.2.4 CURVE SIGN PRESENT BUT NOT ADEQUATE	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0

DETAILED PHASE V ENVIRONMENTAL CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL O/O	S/I N	S/I O/O	CAUSAL OR S/I N	CAUSAL OR S/I O/O
2.1.2.5 SIGNAL LIGHT POORLY PLACED AND/OR NOT ADEQUATELY VISIBLE	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
2.1.2.6 POOR SIGNAL TIMING	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
2.1.2.7 CENTER OR LANE LINES NOT PRESENT OR INADEQUATE	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	2	.2	0	0.0	2	.2
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	3	.3	0	0.0	3	.3
2.1.2.8 EDGE LINES NOT PRESENT OR INADEQUATE	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	3	.3	0	0.0	3	.3
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	3	.3	0	0.0	3	.3

DETAILED PHASE V ENVIRONMENTAL CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
2.1.2.9 OTHER	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	4	.4	0	0.0	4	.4
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	10	1.1	0	0.0	10	1.1
2.1.3 VIEW OBSTRUCTIONS	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	37	4.1	0	0.0	37	4.1
	CERTAIN OR PROBABLE	C	9	8.8	1	1.0	10	9.8
		B	86	9.6	0	0.0	86	9.6
	CERTAIN PROBABLE OR POSSIBLE	C	16	15.7	1	1.0	17	16.7
		B	112	12.5	0	0.0	112	12.5
2.1.3.1 HILL-CRESTS, DIPS, ETC.	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	8	.9	0	0.0	8	.9
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	16	1.8	0	0.0	16	1.8
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	21	2.3	0	0.0	21	2.3
2.1.3.2 ROADSIDE EMBANKMENTS, ESCARPMENTS, ETC.	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	6	.7	0	0.0	6	.7
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	10	1.1	0	0.0	10	1.1
	CERTAIN PROBABLE OR POSSIBLE	C	2	2.0	0	0.0	2	2.0
		B	14	1.6	0	0.0	14	1.6

DETAILED PHASE V ENVIRONMENTAL CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
2.1.3.3 ROADSIDE STRUCTURES AND GROWTH	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	8	.9	0	0.0	8	.9
	CERTAIN OR PROBABLE	C	5	4.9	1	1.0	6	5.9
		B	20	2.2	0	0.0	20	2.2
	CERTAIN PROBABLE OR POSSIBLE	C	7	6.9	1	1.0	8	7.8
		B	25	2.8	0	0.0	25	2.8
2.1.3.4 STOPPED TRAFFIC(NON-PARKED)	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	3	.3	0	0.0	3	.3
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	12	1.3	0	0.0	12	1.3
	CERTAIN PROBABLE OR POSSIBLE	C	3	2.9	0	0.0	3	2.9
		B	14	1.6	0	0.0	14	1.6
2.1.3.5 PARKED VEHICLES	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	10	1.1	0	0.0	10	1.1
	CERTAIN OR PROBABLE	C	3	2.9	0	0.0	3	2.9
		B	17	1.9	0	0.0	17	1.9
	CERTAIN PROBABLE OR POSSIBLE	C	5	4.9	0	0.0	5	4.9
		B	21	2.3	0	0.0	21	2.3
2.1.3.6 OTHER VIEW OBSTRUCTIONS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	3	.3	0	0.0	3	.3
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	15	1.7	0	0.0	15	1.7
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	22	2.5	0	0.0	22	2.5

DETAILED PHASE V ENVIRONMENTAL CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL O/O	S/I N	S/I O/O	CAUSAL OR S/I N	CAUSAL OR S/I O/O
2.1.4 DESIGN PROBLEMS	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	9	1.0	0	0.0	9	1.0
	CERTAIN OR PROBABLE	C	2	2.0	0	0.0	2	2.0
		B	12	1.3	0	0.0	12	1.3
	CERTAIN PROBABLE OR POSSIBLE	C	6	5.9	0	0.0	6	5.9
		B	21	2.3	0	0.0	21	2.3
2.1.4.1 ACCESSES INSUFFICIENTLY LIMITED OR IMPROPERLY PLACED	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
2.1.4.2 INTERSECTION DESIGN PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	4	.4	0	0.0	4	.4
2.1.4.3 ROAD OVERLY NARROW, TWISTING, ETC.	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	6	.7	0	0.0	6	.7
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	8	.9	0	0.0	8	.9
	CERTAIN PROBABLE OR POSSIBLE	C	3	2.9	0	0.0	3	2.9
		B	13	1.5	0	0.0	13	1.5

DETAILED PHASE V ENVIRONMENTAL CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL O/O	S/I N	S/I O/O	CAUSAL OR S/I N	CAUSAL OR S/I O/O
2.1.4.4 TREES AND OTHER OBJECTS TOO CLOSE TO ROAD	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	2	2.0	0	0.0	2	2.0
		B	0	0.0	0	0.0	0	0.0
2.1.4.5 OTHER DESIGN PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	2	.2	0	0.0	2	.2
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	3	.3	0	0.0	3	.3
2.1.5 MAINTENANCE PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	1	.1	0	0.0	1	.1
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	2	.2	0	0.0	2	.2
2.1.5.1 SIGNALS INOPERATIVE	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0

DETAILED PHASE V ENVIRONMENTAL CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL O/O	S/I N	S/I O/O	CAUSAL OR S/I N	CAUSAL OR S/I O/O
2.1.5.2 TRAFFIC CONTROL SIGN MISSING	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
2.1.5.3 TRAFFIC CONTROL SIGN OR SIGNAL OBSCURED	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	1	.1	0	0.0	1	.1
2.1.5.4 OTHER PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
2.2 AMBIENCE RELATED	CERTAIN	C	2	2.0	0	0.0	2	2.0
		B	29	3.2	0	0.0	29	3.2
	CERTAIN OR PROBABLE	C	6	5.9	0	0.0	6	5.9
		B	59	6.6	0	0.0	59	6.6
	CERTAIN PROBABLE OR POSSIBLE	C	10	9.8	0	0.0	10	9.8
		B	91	10.2	0	0.0	91	10.2

DETAILED PHASE V ENVIRONMENTAL CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL O/O	S/I N	S/I O/O	CAUSAL OR S/I N	CAUSAL OR S/I O/O
2.2.1 SPECIAL HAZARDS	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	23	2.6	0	0.0	23	2.6
	CERTAIN OR PROBABLE	C	5	4.9	0	0.0	5	4.9
		B	46	5.1	0	0.0	46	5.1
	CERTAIN PROBABLE OR POSSIBLE	C	9	8.8	0	0.0	9	8.8
		B	64	7.2	0	0.0	64	7.2
2.2.1.1 ANIMAL IN ROAD	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	3	.3	0	0.0	3	.3
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	4	.4	0	0.0	4	.4
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	4	.4	0	0.0	4	.4
2.2.1.2 OBJECT IN ROAD	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	2	.2	0	0.0	2	.2
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	3	.3	0	0.0	3	.3
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	3	.3	0	0.0	3	.3
2.2.1.3 NON-CONTACT VEHICLE CAUSED PROBLEM	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	16	1.8	0	0.0	16	1.8
	CERTAIN OR PROBABLE	C	4	3.9	0	0.0	4	3.9
		B	36	4.0	0	0.0	36	4.0
	CERTAIN PROBABLE OR POSSIBLE	C	8	7.8	0	0.0	8	7.8
		B	54	6.0	0	0.0	54	6.0

DETAILED PHASE V ENVIRONMENTAL CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
2.2.1.4 STOPPED VEHICLE IN ROAD	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
2.2.1.5 OTHER	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
2.2.2 VISION LIMITATION	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	3	.3	0	0.0	3	.3
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	8	.9	0	0.0	8	.9
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	15	1.7	0	0.0	15	1.7
2.2.2.1 RAIN	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1

DETAILED PHASE V ENVIRONMENTAL CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL O/O	S/I N	S/I O/O	CAUSAL OR S/I N	CAUSAL OR S/I O/O
2.2.2.2 SNOW	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
2.2.2.3 FOG	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	2	.2	0	0.0	2	.2
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	4	.4	0	0.0	4	.4
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	6	.7	0	0.0	6	.7
2.2.2.4 DARKNESS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
2.2.2.5 GLARE FROM SUN	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	3	.3	0	0.0	3	.3
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	4	.4	0	0.0	4	.4

DETAILED PHASE V ENVIRONMENTAL CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL O/O	S/I N	S/I O/O	CAUSAL OR S/I N	CAUSAL OR S/I O/O
2.2.2.6 GLARE FROM HEADLIGHTS	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	3	.3	0	0.0	3	.3
2.2.2.7 OTHER	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
2.2.3 AVOIDANCE OBSTRUCTIONS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	3	.3	0	0.0	3	.3
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	5	.6	0	0.0	5	.6
2.2.3.1 PARKED OR STOPPED TRAFFIC	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	3	.3	0	0.0	3	.3

DETAILED PHASE V ENVIRONMENTAL CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
2.2.3.2 TREES AND OTHER FIXED OBJECTS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
2.2.3.3 OTHER	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
2.2.4 RAPID WEATHER CHANGE	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
2.2.4.1 SUDDENLY ENCOUNTERED FOG	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0

DETAILED PHASE V ENVIRONMENTAL CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
2.2.4.2 SUDDENLY ENCOUNTERED SLICK ROADS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
2.2.4.3 OTHER	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
2.2.5 CAMOUFLAGE EFFECT	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	1	.1	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	1	.1	2	.2
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	6	.7	1	.1	7	.8
2.2.5.1 MOTOR VEHICLE BLENDED IN WITH BACKGROUND	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	5	.6	0	0.0	5	.6

DETAILED PHASE V ENVIRONMENTAL CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL O/O	S/I N	S/I O/O	CAUSAL OR S/I N	CAUSAL OR S/I O/O
2.2.5.2 OTHER	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	1	.1	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	1	.1	1	.1
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	1	.1	2	.2
2.2.6 ENVIRONMENTAL OVERLOAD	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	4	.4	0	0.0	4	.4
2.2.7 OTHER AMBIENCE RELATED FACTORS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0

DETAILED PHASE V VEHICLE CAUSATION SUMMARY BY ACCIDENT

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
I. VEHICLE FACTORS	CERTAIN	C	6	5.9	1	1.0	7	6.9
		B	20	2.2	1	.1	21	2.3
	CERTAIN OR PROBABLE	C	11	10.8	2	2.0	13	12.7
		B	49	5.5	2	.2	51	5.7
	CERTAIN PROBABLE OR POSSIBLE	C	30	29.4	1	1.0	31	30.4
		B	86	9.6	13	1.5	99	11.1
1.0 TIRES AND WHEELS	CERTAIN	C	1	1.0	1	1.0	2	2.0
		B	2	.2	1	.1	3	.3
	CERTAIN OR PROBABLE	C	3	2.9	2	2.0	5	4.9
		B	10	1.1	1	.1	11	1.2
	CERTAIN PROBABLE OR POSSIBLE	C	10	9.8	2	2.0	12	11.8
		B	16	1.8	5	.6	21	2.3
1.1 INFLATION	CERTAIN	C	0	0.0	1	1.0	1	1.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	1	1.0	1	1.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	3	2.9	1	1.0	4	3.9
		B	0	0.0	0	0.0	0	0.0
1.1.1 UNDERINFLA- TION	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	2	2.0	0	0.0	2	2.0
		B	0	0.0	0	0.0	0	0.0

DETAILED PHASE V VEHICLE CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
1.1.2 OVERINFLATION	CERTAIN	C	0	0.0	1	1.0	1	1.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	1	1.0	1	1.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	1	1.0	2	2.0
		B	0	0.0	0	0.0	0	0.0
1.1.3 IMPROPER PRESSURE DISTRIBUTION	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
1.2 INADEQUATE TREAD DEPTH	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	0	0.0	1	.1	1	.1
	CERTAIN OR PROBABLE	C	3	2.9	1	1.0	4	3.9
		B	7	.8	1	.1	8	.9
	CERTAIN PROBABLE OR POSSIBLE	C	6	5.9	2	2.0	8	7.8
		B	12	1.3	4	.4	16	1.8
1.3 BLOW-OUT/ SUDDEN FAILURE	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1

DETAILED PHASE V VEHICLE CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
1.4 MISMATCH OF TIRE TYPE AND/OR SIZES	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	1	.1	2	.2
1.5 WHEEL LOSS OR FAILURE	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
1.6 OTHER TIRE OR WHEEL PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
2.0 BRAKE SYSTEM	CERTAIN	C	4	3.9	0	0.0	4	3.9
		B	9	1.0	0	0.0	9	1.0
	CERTAIN OR PROBABLE	C	4	3.9	0	0.0	4	3.9
		B	15	1.7	2	.2	17	1.9
	CERTAIN PROBABLE OR POSSIBLE	C	8	7.8	0	0.0	8	7.8
		B	24	2.7	7	.8	31	3.5

DETAILED PHASE V VEHICLE CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
2.1 GROSS FAILURE (FRONT AND/OR REAR)	CERTAIN	C	4	3.9	0	0.0	4	3.9
		B	9	1.0	0	0.0	9	1.0
	CERTAIN OR PROBABLE	C	4	3.9	0	0.0	4	3.9
		B	11	1.2	2	.2	13	1.5
	CERTAIN PROBABLE OR POSSIBLE	C	4	3.9	0	0.0	4	3.9
		B	15	1.7	3	.3	18	2.0
2.1.1 WHEEL CYLINDER FAILED	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	1	.1	1	.1	2	.2
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	2	.2	2	.2	4	.4
2.1.2 BRAKE LINE FAILED	CERTAIN	C	2	2.0	0	0.0	2	2.0
		B	3	.3	0	0.0	3	.3
	CERTAIN OR PROBABLE	C	2	2.0	0	0.0	2	2.0
		B	3	.3	0	0.0	3	.3
	CERTAIN PROBABLE OR POSSIBLE	C	2	2.0	0	0.0	2	2.0
		B	3	.3	0	0.0	3	.3
2.1.3 MASTER CYLINDER PROBLEM	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2

DETAILED PHASE V VEHICLE CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
2.1.4 INSUFFICIENT FLUID LEVEL	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
2.1.5 ADJUSTMENT MECHANISM LOSS OR FAILURE	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	0	0.0	0	0.0	0	0.0
2.1.6 GROSS FAILURE-OTHER OR UNSPECIFIED	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	3	.3	0	0.0	3	.3
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	5	.6	1	.1	6	.7
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	8	.9	1	.1	9	1.0
2.2 DELAYED BRAKING RESPONSE-- PUMPING REQUIRED	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	3	.3	0	0.0	3	.3

DETAILED PHASE V VEHICLE CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
2.2.1 REQUIRED PUMPING DUE TO IMPROPER ADJUSTMENT	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
2.2.2 REQUIRED PUMPING FOR OTHER REASONS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
2.3 IMBALANCE (PULLED LEFT OR RIGHT)	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	3	.3	0	0.0	3	.3
	CERTAIN PROBABLE OR POSSIBLE	C	2	2.0	0	0.0	2	2.0
		B	5	.6	1	.1	6	.7
2.4 BRAKES GRABBED, LOCKED PREMATURELY, OR WERE OVERSENSITIVE	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0

DETAILED PHASE V VEHICLE CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
2.4.1 DUE TO IMPROPER PROPORTIONING	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
2.4.2 GRABBED OR LOCKED PREMATURELY	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
2.5 PERFORMANCE DEGRADED FOR OTHER REASONS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	2	2.0	0	0.0	2	2.0
		B	1	.1	3	.3	4	.4
3.0 STEERING SYSTEM	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	5	.6	0	0.0	5	.6
	CERTAIN PROBABLE OR POSSIBLE	C	3	2.9	0	0.0	3	2.9
		B	10	1.1	0	0.0	10	1.1

DETAILED PHASE V VEHICLE CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
3.1 EXCESSIVE FREEPLAY	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
	CERTAIN PROBABLE OR POSSIBLE	C	3	2.9	0	0.0	3	2.9
		B	5	.6	0	0.0	5	.6
3.2 BINDING (UNDUE EFFORT REQUIRED)	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
3.3 FREEZING OR LOCKING	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
3.4 OTHER STEERING PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	3	.3	0	0.0	3	.3
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	4	.4	0	0.0	4	.4

DETAILED PHASE V VEHICLE CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
4.0 SUSPENSION PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	2	2.0	0	0.0	2	2.0
		B	2	.2	0	0.0	2	.2
4.1 SHOCK ABSORBER PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
4.1.1 WEAK SHOCK ABSORBERS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
4.1.2 MISSING, BROKEN, OR OTHER SHOCK ABSORBER PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0

DETAILED PHASE V VEHICLE CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
4.2 SPRING PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
4.2.1 MISSING, BROKEN, OR DEFECTIVE SPRINGS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
4.2.2 RAISED REAR END	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
4.2.3 SPRING IMBALANCES (DUE TO HELPER, ETC.)	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0

DETAILED PHASE V VEHICLE CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
4.3 OTHER SUSPENSION PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	2	2.0	0	0.0	2	2.0
		B	0	0.0	0	0.0	0	0.0
5.0 POWER TRAIN AND EXHAUST	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	4	.4	0	0.0	4	.4
5.1 POWER LOSS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	4	.4	0	0.0	4	.4
5.1.1 RAN OUT OF FUEL	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0

DETAILED PHASE V VEHICLE CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
5.1.2 OTHER PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	4	.4	0	0.0	4	.4
5.2 EXHAUST SYSTEM	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	0	0.0	0	0.0	0	0.0
5.2.1 CARBON MONOXIDE LEAKED INTO DRIVERS COMPARTMENT	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	0	0.0	0	0.0	0	0.0
5.2.2 OTHER PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0

DETAILED PHASE V VEHICLE CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
6.0 COMMUNICATION SYSTEMS	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	6	.7	0	0.0	6	.7
	CERTAIN OR PROBABLE	C	2	2.0	0	0.0	2	2.0
		B	15	1.7	0	0.0	15	1.7
	CERTAIN PROBABLE OR POSSIBLE	C	6	5.9	0	0.0	6	5.9
		B	22	2.5	1	.1	23	2.6
6.1 VEHICLE LIGHTS AND SIGNALS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	4	.4	0	0.0	4	.4
	CERTAIN PROBABLE OR POSSIBLE	C	2	2.0	0	0.0	2	2.0
		B	6	.7	1	.1	7	.8
6.1.1 HEADLAMP PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
6.1.1.1 INOPERABLE HEADLAMP	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0

DETAILED PHASE V VEHICLE CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
6.1.1.2 MISAIMED HEADLAMPS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
6.1.1.3 DIRT-OBSCURED HEADLAMPS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
6.1.2 INOPERABLE TAILLIGHTS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	3	.3	0	0.0	3	.3
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	4	.4	0	0.0	4	.4
6.1.3 INOPERABLE TURN SIGNALS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2

DETAILED PHASE V HUMAN CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
6.1.4 INOPERABLE STOP LIGHTS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
6.1.5 REAR LIGHTS/ SIGNALS OBSCURED BY DIRT, ROAD GRIME, ETC.	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
6.1.6 OTHER LIGHT PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	2	2.0	0	0.0	2	2.0
		B	1	.1	1	.1	2	.2
6.2 VEHICLE-RELATED VISION OBSTRUCTIONS	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	5	.6	0	0.0	5	.6
	CERTAIN OR PROBABLE	C	2	2.0	0	0.0	2	2.0
		B	12	1.3	0	0.0	12	1.3
	CERTAIN PROBABLE OR POSSIBLE	C	4	3.9	0	0.0	4	3.9
		B	17	1.9	0	0.0	17	1.9

DETAILED PHASE V VEHICLE CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
6.2.1 DUE TO ICE, SNOW, FROST, WATER OR CONDENSATION ON WINDOWS	CERTAIN	C	1	1.0	0	0.0	1	1.0
		B	5	.6	0	0.0	5	.6
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	11	1.2	0	0.0	11	1.2
	CERTAIN PROBABLE OR POSSIBLE	C	3	2.9	0	0.0	3	2.9
		B	14	1.6	0	0.0	14	1.6
6.2.2 DUE TO CRACKED OR OPAQUE WINDOWS (E.G., CARDBOARD OR DECALS)	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
6.2.3 DUE TO DESIGN OR PLACEMENT OF WINDOWS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
6.2.4 DUE TO OBJECTS IN OR ATTACHED TO VEHICLE	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1

DETAILED PHASE V VEHICLE CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
6.2.5 DUE TO INOPERABLE OR DEFICIENT VISION HARDWARE	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	2	.2	0	0.0	2	.2
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	3	.3	0	0.0	3	.3
6.2.5.1 INOPERABLE OR MISAIMED WINDSHIELD WASHER	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
6.2.5.2 INOPERABLE OR INEFFECTIVE WIPER	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
6.2.5.3 INOPERABLE OR INADEQUATE DEFROSTER	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1

DETAILED PHASE V VEHICLE CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
6.2.5.4 ABSENCE OR CONDITION OF MIRRORS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
6.2.5.5 OTHER PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	1	.1	0	0.0	1	.1
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	1	.1	0	0.0	1	.1
6.3 AUDITORY PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	0	0.0	0	0.0	0	0.0
6.3.1 INOPERABLE OR WEAK HORN	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	1	1.0	0	0.0	1	1.0
		B	0	0.0	0	0.0	0	0.0

DETAILED PHASE V VEHICLE CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
6.3.2 EXCESSIVE RADIO OR TAPE PLAYER VOLUME INSIDE CAR	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
6.3.3 OTHER PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
7.0 DRIVER SEATING AND CONTROLS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	1	.1	0	0.0	1	.1
	CERTAIN PROBABLE OR POSSIBLE	C	2	2.0	0	0.0	2	2.0
		B	6	.7	0	0.0	6	.7
7.1 DRIVER CONTROLS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	1	.1	0	0.0	1	.1
	CERTAIN PROBABLE OR POSSIBLE	C	2	2.0	0	0.0	2	2.0
		B	5	.6	0	0.0	5	.6

DETAILED PHASE V VEHICLE CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL O/O	S/I N	S/I O/O	CAUSAL OR S/I N	CAUSAL OR S/I O/O
7.1.1 STEERING WHEEL PROBLEMS (E.G., SPINNER SNAGGED CLOTHING)	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
7.1.2 BRAKE PEDAL PROBLEM (E.G., PEDAL BROKE OFF)	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
7.1.3 ACCELERATOR PROBLEM (E.G., STUCK)	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	1	1.0	0	0.0	1	1.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	2	2.0	0	0.0	2	2.0
		B	2	.2	0	0.0	2	.2
7.1.4 OTHER PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1

DETAILED PHASE V HUMAN CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
7.2 DRIVER ANTHRO-POMETRIC	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
7.2.1 SEAT LOOSE OR BECAME DETACHED	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
7.2.2 DRIVER NOT POSITIONED TO ADE-QUATELY REACH CONTROLS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
7.2.3 DRIVER NOT POSITIONED TO SEE ADEQUATELY	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0

DETAILED PHASE V VEHICLE CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
7.2.4 OTHER PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
8.0 BODY AND DOORS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
8.1 DOOR CAME OPEN	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
8.2 HOOD CAME OPEN	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0

DETAILED PHASE V VEHICLE CAUSATION SUMMARY BY ACCIDENT

(CONTINUED)

	DEGREE OF CERTAINTY	LEVEL OF STUDY	CAUSAL N	CAUSAL 0/0	S/I N	S/I 0/0	CAUSAL OR S/I N	CAUSAL OR S/I 0/0
8.3 OTHER BODY AND DOOR PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	0	0.0	0	0.0	0	0.0
9.0 OTHER VEHICLE PROBLEMS	CERTAIN	C	0	0.0	0	0.0	0	0.0
		B	1	.1	0	0.0	1	.1
	CERTAIN OR PROBABLE	C	0	0.0	0	0.0	0	0.0
		B	2	.2	0	0.0	2	.2
	CERTAIN PROBABLE OR POSSIBLE	C	0	0.0	0	0.0	0	0.0
		B	5	.6	1	.1	6	.7

Appendix C: Representativeness Data

Table C-1

Comparison of Monroe County with National Vehicle Populations by Model Year (1974)[1]

Model Year	Monroe County (1974)		United States (1974)	
	Number	Percent	Number	Percent
1974	2,022	6.7	6,432,958	6.9
1973	3,653	12.0	11,268,600	12.2
1972	3,507	11.5	10,146,541	11.0
1971	3,072	10.1	8,622,253	9.3
1970	2,781	9.2	8,493,272	9.2
1969	2,826	9.3	8,614,861	9.3
1968	2,704	8.9	7,931,363	8.6
1967	2,305	7.6	6,623,985	7.2
1966	2,070	6.8	6,530,907	7.0
1965	1,868	6.1	5,709,733	6.2
1964	1,339	4.4	3,976,352	4.3
1963	925	3.0	2,823,806	3.0
1962	525	1.7	1,813,219	2.0
1961	228	0.8	900,823	1.0
1960	146	0.5	682,257	0.7
1959	84	0.3	390,763	0.4
Prior to 1959	323	1.1	1,621,140	1.7
Unknown	1	0.0	24,718	0.0
Total	30,379	100.0	92,607,551	100.0

Source: Monroe County—R.L. Polk and Company; U.S.—R.L. Polk and Company.

[1] Passenger cars in operation as of July 1, 1974.

Table C-2

Comparison of Monroe County with National Licensed Drivers by Driver Sex

Sex	Monroe County (1974)		United States (1973*)	
	Number	Percent	Number	Percent
Male	3,675	52.5	68.1	55.6
Female	3,326	47.5	54.3	44.4
Total	7,001	100.0	122.4	100.0

* (in millions)

Sources: Monroe County—Sample taken from Monroe County License Branch, 1974 Applications; U.S.—Accident Facts, 1974 Edition.

Table C-3

Comparison of Monroe County with National Vehicle Populations by Make (1974)[1]

Make	Monroe County (1974)		United States (1974)	
	Number	Percent	Number	Percent
Chevrolet	5,942	19.6	21,666,201	23.4
Ford	5,949	19.6	18,377,025	19.9
Oldsmobile	3,086	10.2	6,019,464	6.5
Buick	2,275	7.5	5,942,287	6.4
Pontiac	1,898	6.2	6,872,509	7.4
Plymouth	1,594	5.2	6,333,759	6.9
Mercury	1,549	5.1	3,360,929	3.6
Dodge	1,779	5.9	5,204,137	5.6
American Motors	558	1.8	2,905,373	3.1
Cadillac	489	1.6	2,254,339	2.4
Chrysler	405	1.3	1,816,738	2.0
Lincoln	233	0.8	632,354	0.7
Imperial	31	0.1	154,561	0.2
Studebaker	30	0.1	92,814	0.1
Desoto	6	0.0	22,194	0.0
Miscellaneous	4,555	15.0	10,952,867	11.8
Total	30,379	100.0	92,607,551	100.0

Source: Monroe County—R.L. Polk and Company; U.S.—R.L. Polk and Company.

[1] Passenger cars in operation as of July 1, 1974.

Table C-4

Comparison of Monroe County with National Licensed Drivers by Age

Age	Monroe County (1974)		United States (1973*)	
	Number	Percent	Number	Percent
<20	880	12.6	12.6	10.3
20-24	1,612	23.0	13.9	11.4
25-34	1,765	25.2	25.9	21.2
35-44	862	12.3	22.8	18.6
45-54	880	12.6	22.2	18.1
55-64	548	7.8	14.5	11.8
65 and over	454	6.5	10.5	8.6
Total	7,001	100.0	122.4	100.0

* (in millions)

Sources: Monroe County—Sample taken from Monroe County License Branch, 1974 Applications; U.S.—Accident Facts, 1974 Edition.

Table C-5

Comparison of Monroe County with National Road and Street Mileage by System and Type of Surface

System and Type of Surface	Monroe County (1968)		United States (1973)	
	Number	Percent	Number	Percent
County	658.39	75.9	2,249,446	59.1
Non-Surfaced	119.06	13.7	557,628	14.7
Surfaced	539.33	62.2	1,691,818	44.4
Municipal	116.38	13.4	549,537	14.4
Non-Surfaced	5.17	0.6	25,241	.6
Surfaced	111.21	12.8	524,296	13.8
State & U.S.	93.03	10.7	1,007,900	26.5
Non-Surfaced	—	—	182,396	4.8
Surfaced	93.03	10.7	825,504	21.7
Total	867.80	100.0	3,806,883	100.0
Non-Surfaced	124.23	14.3	765,265	20.1
Surfaced	743.57	85.7	3,041,618	79.9

Sources: Monroe County—Indiana State Highway Commission (Planning Division), 1968 Road Inventory; U.S.—Highway Statistics, 1973.

Table C-6

Comparison of Monroe County with National Accidents by Hour of Accident

Hour of Accident	Monroe County (1974)		United States (1973)	
	Number	Percent	Number	Percent
Midnight to 3:59 pm	246	8.2	NR	8.5
4:00 am to 7:59 am	195	6.5	NR	7.1
8:00 am to 11:59 am	524	17.4	NR	16.9
Noon to 3:59 pm	775	25.7	NR	24.9
4:00 pm to 7:59 pm	838	27.8	NR	27.6
8:00 pm to 11:59 pm	432	14.4	NR	15.0
Total	3,010	100.0	NR	100.0

NR—not reported

Sources: Monroe County—1974 Indiana State Police data; U.S. Accident Facts, 1974 Edition.

Table C-7

Comparison of Monroe County with National Accident-Involved Vehicle Populations by Vehicle Type

Vehicle Type	Monroe County (1974)		United States (1973*)	
	Number	Percent	Number	Percent
Passenger Vehicle	4,759	85.4	23.3	83.0
Truck	690	12.4	3.7	13.2
Bus	45	0.8	.182	0.6
Motorcycle	75	1.3	.36	1.3
Other Vehicle	3	0.1	.538	1.9
Total	5,572	100.0	28.08	100.0

* (in millions)

Passenger Vehicle: Any motor vehicle primarily intended for the transport of passengers but generally having no more than nine (9) seats, commonly referred to as a passenger car. Passenger vehicles include: station wagon, taxicab, hearse, ambulance, and police patrol car. Over-the-road-recreational vehicles such as camper or motor homes (as distinguished from off-road, e.g., snowmobiles, swamp buggies, or all-terrain-vehicles) are predominantly registered as passenger vehicles, although many are built on truck chassis, or represent bus or van-type truck conversions. Over-the-road-recreational vehicles should be coded as passenger vehicles.

Truck: A motor vehicle primarily intended for the transport of cargo or special equipment, and will generally be so defined by applicable motor vehicle registration laws. Truck includes truck tractors with or without trailer, and motorized fire apparatus.

Bus: A motor vehicle built for the transport of usually at least ten (10) persons, including the driver. All school buses are included in this category as are electric trolley buses which do not operate on rolls.

Motorcycle: A two-wheeled motor vehicle having one or more riding saddles, and sometimes a third wheel for the support of a sidecar. The sidecar is considered a part of the motorcycle. Motorcycle includes motorized bicycle, scooter, or tricycle.

Other Vehicle: Any road vehicle not defined as passenger vehicle, truck, bus or motorcycle, other motor vehicles, and, non-road vehicles such as railway trains or vehicles but not aircraft or watercraft.

Sources: Monroe County—Indiana State Police Statistics, 1974; U.S. Accident Facts, 1974 Edition.

Table C-8

Comparison of Monroe County with National Accident-Involved Driver Populations, by Driver Sex

Sex	Monroe County (1974)		United States (1973*)	
	Number	Percent	Number	Percent
Male	3,577	67.4	20.2	71.9
Female	1,732	32.6	7.9	28.1
Total	5,309	100.0	28.1	100.0

* (in millions)

Sources: Monroe County—Indiana State Police Statistics, 1974; U.S. Accident Facts—1974 Edition.

Table C-9

Comparison of Monroe County with National Accidents by Urban and Rural Places

Place of Occurrence	Monroe County (1973)		United States (1973*)	
	Number	Percent	Number	Percent
Urban Area	2,058	67.1	11.7868	72.1
Rural Area	1,010	32.9	4.5613	27.9
Total	3,068	100.0	16.3481	100.0

* (in millions)

Urban Area: An area including and adjacent to a municipality or other known place of 5,000 or more population, as shown by the latest Federal census, whose boundaries shall be those fixed by the state highway departments, subject to approval of the U.S. Department of Transportation.

Rural Area: Any area that does not meet the specifications for an urban area.

Sources: Monroe County—Indiana State Police Statistics, 1974; U.S.—Accident Facts—1974 Edition.

Table C-10

Comparison of Monroe County with National Accidents by Light Conditions

Light Conditions	Monroe County (1974)		United States (1972)	
	Number	Percent	Number	Percent
Daylight	2,040	69.4	956,803	63.2
Dawn or Dusk	125	4.2	68,924	4.6
Darkness	776	26.4	487,889	32.2
Total	2,941	100.0	1,513,616	100.0

Daylight: The light level between sunrise and sunset. Accidents on roadways with permanent illumination at levels such that headlights need not be used, as in many urban tunnels, should be coded as "daylight" accidents.

Dawn or Dusk: The ambient light level for the hour before sunrise, and the hour after sunset, respectively.

Darkness: The ambient light level between dusk and dawn. Roads may or may not be illuminated by streetlights. Headlights are normally required for visibility during darkness.

Sources: Monroe County—Indiana State Police Statistics, 1974; U.S.—National Accident Summary File, 1972 Statistics.

Table C-11

Comparison of Monroe County with National Accidents by Type of Accident

Type of Accident	Monroe County (1974)		United States (1972)	
	Number	Percent	Number	Percent
Collision with Pedestrian	18	0.6	44,474	2.9
Collision with Non-Motor Vehicle	37	1.2	74,410	4.8
Collision with Fixed Object	201	6.6	140,019	9.1
Other Non-Collision Running Off Road	357	11.6	137,921	9.0
Non-Collision Over-turning	16	0.5	17,620	1.1
Collision Involving Other Object or Animal	247	8.1	145,098	9.4
Collision with Other Motor Vehicle(s)	2,192	71.4	980,093	63.7
Total	3,068	100.0	1,539,635	100.0

Collision with Pedestrian: Any accident involving a motor vehicle in transport and a pedestrian.

Collision with Non-Motor Vehicle(s): Any accident involving a motor vehicle in transport and a non-motor vehicle.

Collision with Fixed Object: Any accident involving a motor vehicle in transport and a fixed object.

Other Non-Collision Accident: Any accident involving motor vehicle in transport, other than running off road, overturning, and collision.

Running Off Road: A motor vehicle in transport leaves the roadway without colliding with any person, object, or vehicle on the roadway, but in such a way as to produce injury or damage.

Non-Collision, Overturning: Any accident in which a motor vehicle in transport overturns for any reason except where overturning is result of collision.

Collision Involving Other Object or Animal: Any accident involving a motor vehicle in transport and any other object which is moveable or moving, but not fixed, or an animal herded or unattended.

Collision with Other Motor Vehicle(s): Any accident involving at least two motor vehicles upon the same roadway or upon roadways within an intersection.

Sources: Monroe County—Indiana State Police Statistics, 1974; U.S. National Accident Summary File, 1972 Statistics.

Table C-12

Comparison of Monroe County with National Accidents by Road Surface Condition

Condition of Road Surface	Monroe County (1974)		United States (1973)	
	Number	Percent	Number	Percent
Dry	1,882	63.9	NR	69.4
Wet	845	28.7	NR	20.9
Snowy or Icy	208	7.1	NR	9.2
Other Condition or Not Stated	11	.4	NR	0.5
Total	2,946	100.0	NR	100.0

NR—Not reported

Dry: A road free of water or any other form of precipitation (maximum adhesion for a given tire).

Wet: A road has water on its surface, but is neither snowy nor icy.

Snowy or Icy: A road has snowfall precipitation or slush, or icy from freezing dew or rain, melting and refreezing snow (including hail), or both, on its surface.

Other Condition or Not Stated: Includes oily, muddy, slippery surfaces, and new road surfaces that have not hardened.

Sources: Monroe County—Indiana State Police Accident Statistics, 1974; U.S. Accident Facts—1974 Edition.

Table C-13

Comparison of Monroe County with National Accident-Involved Driver Populations, by Driver Age

Age of Driver	Monroe County (1974)		United States (1973*)	
	Number	Percent	Number	Percent
Under 20	3,046	19.4	5.7	20.6
20-24	4,392	28.0	5.2	18.8
25-34	3,551	22.6	5.9	21.3
35-44	1,797	11.4	3.9	14.1
45-54	1,396	8.9	3.3	11.9
55-64	859	5.5	2.2	7.9
Over 64	667	4.2	1.5	5.4
Total	15,708	100.0	27.7	100.0

* (in millions)

Age: The age of individual concerned is the number of whole years between birth and the accident. Age is often not shown in the source documents but derived by subtracting the reported date of birth from the date of the accident. Exceptions are pedestrians, pedalcyclists, and other cases in which the age is obtained from the individual or by estimation.

Sources: Monroe County—Indiana State Police Statistics, 1974; U.S. Accident Facts—1974 Edition.

Table C-14

Comparison of Monroe County with National Accidents by Severity of Accident

Severity	Monroe County (1974)		United States (1972*)	
	Number	Percent	Number	Percent
Fatality	9	0.3	.012	0.8
Personal Injury	692	22.6	.560	36.4
Property Damage	2,367	77.1	.968	62.8
Total	3,068	100.0	1.540	100.0

* (in millions)

Fatal Accidents: Any motor vehicle or other road vehicle accident that results in fatal injuries to one or more persons.

Non-fatal Injury Accident: Any motor vehicle or other road vehicle accident, other than a fatal accident, that results in injuries, other than fatal, to one or more persons.

Property Damage (Non-injury) Accident: Any motor vehicle accident in which there is no injury to any person, but only reported damage to a motor vehicle or other road vehicle or to other property, including injury to domestic animals. (The legal requirements for reporting of property damage (non-injury) accidents vary among states from necessity for towing one vehicle from the scene to damage amounts ranging from $400 to $25.)

Sources: Monroe County—Indiana State Police Accident Statistics, 1974; U.S. National Accident Summary File, 1972 Statistics.

Table C-15

Comparison of Phase V On-Site and In-Depth Accidents with All 1974 Monroe County Accidents by Urban and Rural Places

URBAN AND RURAL PLACES	ON-SITE		IN-DEPTH		MONROE COUNTY	
	N	0/0	N	0/0	N	0/0
RURAL AREA	301	34.1	37	36.6	1010	32.9
URBAN AREA	582	65.9	64	63.4	2058	67.1
TOTAL	883	100.0	101	100.0	3068	100.0
CHI-SQUARE	.55 NS		.63 NS		//////////////	

* = P LE .05 ** = P LE .01 *** = P LE .001

Table C-16

Comparison of Phase V On-Site and In-Depth Accidents with All 1974 Monroe County Accidents by Light Conditions

LIGHT CONDITIONS	ON-SITE		IN-DEPTH		MCNROE CCUNTY	
	N	C/O	N	O/O	N	O/O
CAYLIGHT	575	68.7	69	71.9	2040	69.4
CARKNESS	229	27.4	24	25.0	776	26.4
CAWN OR CUSK	33	3.9	3	3.1	125	4.3
TOTAL	837	100.0	96	100.0	2941	100.0
CHI-SQUARE	.54 NS		.44 NS		//////////////	

* = P LE .05   ** = P LE .01   *** = P LE .001

Table C-17

Comparison of Phase V On-Site and In-Depth Accidents with All 1974 Monroe County Accidents by Month of Accident

MONTH OF ACCIDENT	ON-SITE		IN-DEPTH		MONROE COUNTY	
	N	0/0	N	0/0	N	0/0
JANUARY THRU MARCH	213	23.8	28	27.5	744	24.3
APRIL THRU JUNE	188	21.0	22	21.6	668	21.8
JULY THRU SEPTEMBER	230	25.7	25	24.5	789	25.7
OCTOBER THRU DECEMBER	263	29.4	27	26.5	867	28.3
TOTAL	894	100.0	102	100.0	3068	100.0
CHI-SQUARE	.72 NS		.61 NS		//////////////	

* = P LE .05 ** = P LE .01 *** = P LE .001

Table C-18

Comparison of Phase V On-Site and In-Depth Accidents with All 1974 Monroe County Accidents by Day of Week

DAY OF WEEK	ON-SITE		IN-DEPTH		MONROE COUNTY	
	N	0/0	N	0/0	N	0/0
SUNDAY	127	14.2	11	10.8	462	15.1
MONDAY	124	13.9	15	14.7	420	13.7
TUESDAY	98	11.0	21	20.6	364	11.9
WEDNESDAY	135	15.1	20	19.6	402	13.1
THURSDAY	155	17.3	19	18.6	585	19.1
FRIDAY	148	16.6	8	7.8	540	17.6
SATURDAY	107	12.0	8	7.8	295	9.6
TOTAL	894	100.0	102	100.0	3068	100.0
CHI-SQUARE	10.90 NS		17.01 **		//////////////	

* = P LE .05 ** = P LE .01 *** = P LE .001

Table C-19

Comparison of Phase V On-Site and In-Depth Accidents with National Estimates by Weather Condition

WEATHER CONDITION	ON-SITE		IN-DEPTH		MONROE COUNTY	
	N	0/0	N	0/0	N	0/0
CLEAR	621	74.8	70	72.9	2074	71.1
RAINING	156	18.8	23	24.0	619	21.2
SNOWING	37	4.5	2	2.1	141	4.8
FOG	8	1.0	0	0.0	24	.8
OTHER	8	1.0	1	1.0	60	2.1
TOTAL	830	100.0	96	100.0	2918	100.0
CHI-SQUARE	9.18 NS		3.16 NS		//////////////	

* = P LE .05   ** = P LE .01   *** = P LE .001

Table C-20

Comparison of Phase V On-Site and In-Depth Accidents with National Estimates by Hour of Day

HOUR	ON-SITE		IN-DEPTH		MONROE COUNTY	
	N	0/0	N	0/0	N	0/0
MIDNIGHT TO 03*59AM	69	7.7	7	6.9	246	8.2
04*00AM TO 07*59AM	42	4.7	4	3.9	195	6.5
08*00AM TO 11*59AM	166	18.6	29	28.4	524	17.4
NOON TO 03*59PM	268	30.0	27	26.5	775	25.7
04*00PM TO 07*59PM	253	28.3	27	26.5	838	27.8
08*00PM TO 11*59PM	96	10.7	8	7.8	432	14.4
TOTAL	894	100.0	102	100.0	3010	100.0
CHI-SQUARE	19.71 **		11.46 *		//////////////	

* = P LE .05 ** = P LE .01 *** = P LE .001

Table C-21

Comparison of Phase V On-Site and In-Depth Accidents with National Estimates by Severity of Accident

SEVERITY OF ACCIDENT	ON-SITE		IN-DEPTH		MONROE COUNTY	
	N	O/O	N	O/O	N	O/O
FATALITY	4	.5	1	1.0	9	.3
PERSONAL INJURY	230	26.8	25	25.3	692	22.6
PROPERTY DAMAGE	625	72.8	73	73.7	2367	77.2
TOTAL	859	100.0	99	100.0	3068	100.0
CHI-SQUARE	9.80 **		2.20 NS		//////////////	

* = P LE .05   ** = P LE .01   *** = P LE .001

Table C-22

Comparison of Phase V On-Site and In-Depth Accidents with National Estimates by Road Surface Condition

ROAD SURFACE CONDITIONS	ON-SITE		IN-DEPTH		MONROE COUNTY	
	N	0/0	N	0/0	N	0/0
DRY	586	70.0	63	65.6	1882	64.1
WET	220	26.3	30	31.3	845	28.8
SNOWY OR ICY	31	3.7	3	3.1	208	7.1
TOTAL	837	100.0	96	100.0	2935	100.0
CHI-SQUARE	19.87***		2.36 NS		//////////////	

* = P LE .05   ** = P LE .01   *** = P LE .001

Table C-23

Comparison of Phase V On-Site and In-Depth Accidents with All 1974 Monroe County Accidents by Accident Type

ACCIDENT TYPE	ON-SITE		IN-DEPTH		MONROE COUNTY	
	N	0/0	N	0/0	N	0/0
COLLISION WITH PEDESTRIAN	0	0.0	0	0.0	18	.6
COLLISION WITH NON-MOTOR VEHICLE	5	.6	0	0.0	37	1.2
COLLISION WITH FIXED OBJECT	15	1.7	6	5.9	201	6.6
OTHER NONCOLLISION RUNNING OFF ROAD	174	19.5	31	30.7	357	11.6
NONCOLLISION OVER TURNING	2	.2	1	1.0	16	.5
COLLISION INVOL-VING OTHER OBJECT OR ANIMAL	28	3.1	1	1.0	247	8.1
COLLISION WITH OTHER MOTOR VEHICLE(S)	667	74.9	62	61.4	2192	71.4
TOTAL	891	100.0	101	100.0	3068	100.0
CHI-SQUARE	117.85***		41.50***		//////////////	

* = P LE .05 ** = P LE .01 *** = P LE .001

Table C-24

Comparison of Phase V On-Site and In-Depth Accidents with All 1974 Monroe County Accidents by Character of Location

CHARACTER OF LOCATION	ON-SITE		IN-DEPTH		MONROE COUNTY	
	N	0/0	N	0/0	N	0/0
INTERSECTION	451	50.6	48	47.5	1197	39.0
CULVERT	0	0.0	0	0.0	2	.1
INTERSECTION ALLEY OR DRIVEWAY	105	11.8	11	10.9	369	12.0
RAILROAD CROSSING	1	.1	0	0.0	19	.6
BRIDGE OR OVERPASS	3	.3	0	0.0	11	.4
UNDERPASS	0	0.0	0	0.0	2	.1
ALL OTHERS	331	37.1	42	41.6	1467	47.8
TOTAL	891	100.0	101	100.0	3067	100.0
CHI-SQUARE	56.84***		3.92 NS		//////////////	

* = P LE .05 ** = P LE .01 *** = P LE .001

Table C-25

Comparison of Phase V On-Site and In-Depth Accidents with All 1974 Monroe County Accidents by Investigation Source

INVESTIGATION SOURCE	ON-SITE		IN-DEPTH		MONROE COUNTY	
	N	0/0	N	0/0	N	0/0
WAS NOT INVESTIGATED	0	0.0	0	0.0	821	26.8
STATE POLICE INVESTIGATED	77	9.1	5	5.2	317	10.3
SHERIFF INVESTIGATED	200	23.6	24	25.0	479	15.6
CITY POLICE INVESTIGATED	546	64.4	64	66.7	1444	47.1
OTHER INVESTIGATED	25	2.9	3	3.1	2	.1
TOTAL	848	100.0	96	100.0	3063	100.0
CHI-SQUARE	1395.66***		178.97***		//////////////	

* = P LE .05   ** = P LE .01   *** = P LE .001

Table C-26

Comparison of Phase V On-Site and In-Depth Accidents with All 1974 Monroe County Accidents by Driver Sex

SEX	ON-SITE		IN-DEPTH		MONROE COUNTY	
	N	O/O	N	O/O	N	O/O
MALE	1074	68.7	96	62.3	3577	67.4
FEMALE	490	31.3	58	37.7	1732	32.6
TOTAL	1564	100.0	154	100.0	5309	100.0
CHI-SQUARE	1.19 NS		1.78 NS		//////////////	

* = P LE .05 ** = P LE .01 *** = P LE .001

Table C-27

Comparison of Phase V On-Site and In-Depth Accidents with All 1974 Monroe County Accidents by Driver Age

DRIVER AGE	ON-SITE		IN-DEPTH		MONROE COUNTY	
	N	O/O	N	O/O	N	O/O
UNDER 20	316	20.4	27	17.5	1017	20.5
20 - 24	459	29.6	67	43.5	1357	27.3
25 - 34	331	21.3	28	18.2	1145	23.1
35 - 44	142	9.2	14	9.1	531	10.7
45 - 54	148	9.5	10	6.5	434	8.7
55 - 64	84	5.4	3	1.9	268	5.4
OVER 64	71	4.6	5	3.2	215	4.3
TOTAL	1551	100.0	154	100.0	4967	100.0
CHI-SQUARE	9.70 NS		22.07 **		//////////////	

* = P LE .05 ** = P LE .01 *** = P LE .001

Table C-28

Comparison of Phase V On-Site and In-Depth Accidents with All 1974 Monroe County Accidents by Status of Driver with Respect to Arrest

ARREST	ON-SITE		IN-DEPTH		MONROE COUNTY	
	N	0/0	N	0/0	N	0/0
DRIVER NOT ARRESTED	1314	90.9	131	93.6	3254	89.8
ARRESTED FOR DRIVING UNDER THE INFLUENCE	48	3.3	1	.7	120	3.3
ARRESTED FOR OTHER VIOLATION	83	5.7	8	5.7	250	6.9
TOTAL	1445	100.0	140	100.0	3624	100.0
CHI-SQUARE	3.00 NS		3.36 NS		//////////////	

* = P LE .05 ** = P LE .01 *** = P LE .001

Table C-29

Comparison of Phase V On-Site and In-Depth Accidents with All 1974 Monroe County Accidents by Driver's License

DRIVER'S LICENSE	ON-SITE N	ON-SITE 0/0	IN-DEPTH N	IN-DEPTH 0/0	MONROE COUNTY N	MONROE COUNTY 0/0
LICENSED IN STATE OPERATORS, BEGINNERS, ETC.	1345	94.0	124	90.5	4797	94.9
RESIDENT OF STATE, NO LICENSE	20	1.4	1	.7	36	.7
NON-RESIDENT	66	4.6	12	8.8	220	4.4
TOTAL	1431	100.0	137	100.0	5053	100.0
CHI-SQUARE	9.78 **		6.39 *		//////////////	

* = P LE .05   ** = P LE .01   *** = P LE .001

Table C-30

Comparison of Phase V On-Site and In-Depth Accidents with all 1974 Monroe County Accidents by Vehicle Type

VEHICLE TYPE	ON-SITE		IN-DEPTH		MONROE COUNTY	
	N	O/O	N	O/O	N	O/O
PASSENGER VEHICLE	1403	85.8	149	89.8	4759	85.4
TRUCK	195	11.9	15	9.0	690	12.4
BUS	0	0.0	0	0.0	45	.8
MOTORCYCLE	36	2.2	2	1.2	75	1.3
OTHER VECHICLE	1	.1	0	0.0	3	.1
TOTAL	1635	100.0	166	100.0	5572	100.0
CHI-SQUARE	22.42***		3.32 NS		//////////////	

* = P LE .05 ** = P LE .01 *** = P LE .001

Table C-31

Comparison of Phases II, III, IV and V On-Site and In-Depth Accidents with 1972-73-74 Monroe County Accidents by Urban and Rural Places

URBAN AND RURAL PLACES	ON-SITE		IN-DEPTH		MONROE COUNTY	
	N	0/0	N	0/0	N	0/0
RURAL AREA	754	35.0	164	40.3	3412	35.3
URBAN AREA	1401	65.0	243	59.7	6242	64.7
TOTAL	2155	100.0	407	100.0	9654	100.0
CHI-SQUARE	.12 NS		4.37 *		//////////////	

* = P LE .05 ** = P LE .01 *** = P LE .001

Table C-32

Comparison of Phases II, III, IV and V On-Site and In-Depth Accidents with 1972-73-74 Monroe County Accidents by Day of Week

DAY OF WEEK	ON-SITE		IN-DEPTH		MONROE COUNTY	
	N	0/0	N	0/0	N	0/0
SUNDAY	305	14.1	57	14.0	1362	14.1
MONDAY	321	14.8	69	16.9	1329	13.8
TUESDAY	282	13.0	75	18.4	1267	13.1
WEDNESDAY	325	15.0	64	15.7	1279	13.2
THURSDAY	362	16.7	57	14.0	1830	19.0
FRIDAY	334	15.4	45	11.0	1627	16.9
SATURDAY	237	10.9	41	10.0	960	9.9
TOTAL	2166	100.0	408	100.0	9654	100.0
CHI-SQUARE	17.37 **		26.93***		//////////////	

* = P LE .05 ** = P LE .01 *** = P LE .001

Table C-33

Comparison of Phases II, III, IV and V On-Site and In-Depth Accidents with 1972-73-74 Monroe County Accidents by Month of Accident

MONTH OF ACCIDENT	ON-SITE		IN-DEPTH		MONROE COUNTY	
	N	O/O	N	O/O	N	O/O
JANUARY THRU MARCH	575	27.0	110	28.9	2295	23.8
APRIL THRU JUNE	500	23.5	85	22.3	2207	22.9
JULY THRU SEPTEMBER	484	22.8	76	19.9	2436	25.2
OCTOBER THRU DECEMBER	567	26.7	110	28.9	2716	28.1
TOTAL	2126	100.0	381	100.0	9654	100.0
CHI-SQUARE	16.73***		8.51 *		//////////////	

* = P LE .05 ** = P LE .01 *** = P LE .001

Table C-34

Comparison of Phases II, III, IV and V On-Site and In-Depth Accidents with 1972-73-74 Monroe County Accidents by Severity of Accident

SEVERITY OF ACCIDENT	ON-SITE		IN-DEPTH		MONROE COUNTY	
	N	O/O	N	O/O	N	O/O
FATALITY	16	.8	7	1.7	39	.4
PERSONAL INJURY	541	25.4	116	28.6	2090	21.6
PROPERTY DAMAGE	1570	73.8	282	69.6	7525	77.9
TOTAL	2127	100.0	405	100.0	9654	100.0
CHI-SQUARE	25.13***		30.33***		//////////////	

* = P LE .05 ** = P LE .01 *** = P LE .001

Table C-35

Comparison of Phases II, III, IV and V On-Site and In-Depth Accidents with 1972-73-74 Monroe County Accidents by Accident Type

ACCIDENT TYPE	ON-SITE		IN-DEPTH		MONROE COUNTY	
	N	0/0	N	0/0	N	0/0
COLLISION WITH PEDESTRIAN	11	.5	3	.7	80	.8
COLLISION WITH NON-MOTOR VEHICLE	18	.8	2	.5	106	1.1
COLLISION WITH FIXED OBJECT	41	1.9	15	3.7	571	5.9
OTHER NONCOLLISION RUNNING OFF ROAD	356	16.5	103	25.3	1134	11.7
NONCOLLISION OVER TURNING	12	.6	4	1.0	55	.6
COLLISION INVOLVING OTHER OBJECT OR ANIMAL	67	3.1	14	3.4	737	7.6
COLLISION WITH OTHER MOTOR VEHICLE(S)	1658	76.7	266	65.4	6971	72.2
TOTAL	2163	100.0	407	100.0	9654	100.0
CHI-SQUARE	168.27***		31.79***		//////////////	

* = P LE .05 ** = P LE .01 *** = P LE .001

Table C-36

Comparison of Phases II, III, IV and V On-Site and In-Depth Accidents with 1972-73-74 Monroe County Accidents by Light Condition

LIGHT CONDITIONS	ON-SITE		IN-DEPTH		MONROE COUNTY	
	N	0/0	N	0/0	N	0/0
DAYLIGHT	1555	74.5	315	79.1	6426	69.5
DARKNESS	466	22.3	72	18.1	2422	26.2
DAWN OR DUSK	66	3.2	11	2.8	396	4.3
TOTAL	2087	100.0	398	100.0	9244	100.0
CHI-SQUARE	25.56***		17.45***		//////////////	

* = P LE .05   ** = P LE .01   *** = P LE .001

Table C-37

Comparison of Phases II, III, IV and V On-Site and In-Depth Accidents with 1972-73-74 Monroe County Accidents by Road Surface Condition

ROAD SURFACE CONDITIONS	ON-SITE		IN-DEPTH		MONROE COUNTY	
	N	0/0	N	0/0	N	0/0
DRY	1496	71.9	279	70.5	6084	66.1
WET	494	23.7	98	24.7	2524	27.4
SNOWY OR ICY	92	4.4	19	4.8	595	6.5
TOTAL	2082	100.0	396	100.0	9203	100.0
CHI-SQUARE	34.27***		3.87 NS		//////////////	

* = P LE .05 ** = P LE .01 *** = P LE .001

Table C-38

Comparison of Phases II, III, IV and V On-Site and In-Depth Accidents with 1972-73-74 Monroe County Accidents by Weather Condition

WEATHER CONDITION	ON-SITE		IN-DEPTH		MONROE COUNTY	
	N	0/0	N	0/0	N	0/0
CLEAR	1605	77.3	299	75.1	6551	71.3
RAINING	355	17.1	80	20.1	1899	20.7
SNOWING	81	3.9	12	3.0	414	4.5
FOG	11	.5	1	.3	84	.9
OTHER	24	1.2	6	1.5	239	2.6
TOTAL	2076	100.0	398	100.0	9187	100.0
CHI-SQUARE	45.01***		6.59 NS		//////////////	

* = P LE .05 ** = P LE .01 *** = P LE .001

Table C-39

Comparison of Phases II, III, IV and V On-Site and In-Depth Accidents with 1972-73-74 Monroe County Accidents by Hour of Day

HOUR	ON-SITE N	ON-SITE O/O	IN-DEPTH N	IN-DEPTH O/O	MONROE COUNTY N	MONROE COUNTY O/O
MIDNIGHT TO 03*59AM	87	4.0	14	3.4	690	7.3
04*00AM TO 07*59AM	71	3.3	13	3.2	630	6.7
08*00AM TO 11*59AM	281	13.0	64	15.7	1694	17.9
NOON TO 03*59PM	798	37.0	161	39.5	2602	27.5
04*00PM TO 07*59PM	661	30.6	113	27.7	2544	26.9
08*00PM TO 11*59PM	259	12.0	43	10.5	1290	13.7
TOTAL	2157	100.0	408	100.0	9450	100.0
CHI-SQUARE	182.79***		40.99***		//////	//////

* = P LE .05 ** = P LE .01 *** = P LE .001

Table C-40

Comparison of Phases II, III, IV and V On-Site and In-Depth Accidents with 1972-73-74 Monroe County Accidents by Character of Location

CHARACTER OF LOCATION	ON-SITE N	ON-SITE O/O	IN-DEPTH N	IN-DEPTH O/O	MONROE COUNTY N	MONROE COUNTY O/O
INTERSECTION	1064	49.2	174	42.8	3720	38.5
CULVERT	2	.1	1	.2	11	.1
INTERSECTION ALLEY OR DRIVEWAY	293	13.6	50	12.3	1137	11.8
RAILROAD CROSSING	7	.3	1	.2	51	.5
BRIDGE OR OVERPASS	13	.6	1	.2	51	.5
UNDERPASS	3	.1	0	0.0	6	.1
ALL OTHERS	780	36.1	180	44.2	4677	48.5
TOTAL	2162	100.0	407	100.0	9653	100.0
CHI-SQUARE	142.10***		5.57 NS		//////////////	

* = P LE .05 ** = P LE .01 *** = P LE .001

Table C-41

Comparison of Phases II, III, IV and V On-Site and In-Depth Accidents with 1972-73-74 Monroe County Accidents by Investigation Source

INVESTIGATION SOURCE	ON-SITE N	ON-SITE O/O	IN-DEPTH N	IN-DEPTH O/O	MONROE COUNTY N	MONROE COUNTY O/O
WAS NOT INVESTIGATED	0	0.0	0	0.0	2402	27.1
STATE POLICE INVESTIGATED	257	12.2	50	12.5	950	10.7
SHERIFF INVESTIGATED	492	23.3	112	28.1	1547	17.5
CITY POLICE INVESTIGATED	1322	62.7	231	57.9	3955	44.6
OTHER INVESTIGATED	38	1.8	6	1.5	6	.1
TOTAL	2109	100.0	399	100.0	8860	100.0
CHI-SQUARE	1707.89***		272.32***		//////////////	

* = P LE .05 ** = P LE .01 *** = P LE .001

Table C-42

Comparison of Phases II, III, IV and V On-Site and In-Depth Accidents with 1972-73-74 Monroe County Accidents by Driver Sex

SEX	ON-SITE N	ON-SITE O/O	IN-DEPTH N	IN-DEPTH O/O	MONROE COUNTY N	MONROE COUNTY O/O
MALE	2601	66.9	431	65.7	11403	67.9
FEMALE	1287	33.1	225	34.3	5390	32.1
TOTAL	3888	100.0	656	100.0	16793	100.0
CHI-SQUARE	1.80 NS		1.46 NS		//////////////	

* = P LE .05 ** = P LE .01 *** = P LE .001

Table C-43

Comparison of Phases II, III, IV and V On-Site and In-Depth Accidents with 1972-73-74 Monroe County Accidents by Driver Age

DRIVER AGE	ON-SITE		IN-DEPTH		MONROE COUNTY	
	N	O/O	N	O/O	N	O/O
UNDER 20	769	19.9	139	21.4	3046	19.4
20 - 24	1129	29.2	203	31.2	4392	28.0
25 - 34	809	20.9	140	21.5	3551	22.6
35 - 44	409	10.6	66	10.2	1797	11.4
45 - 54	354	9.2	65	10.0	1396	8.9
55 - 64	209	5.4	17	2.6	859	5.5
OVER 64	183	4.7	20	3.1	667	4.2
TOTAL	3862	100.0	650	100.0	15709	100.0
CHI-SQUARE	12.48 NS		17.76 **		//////////////	

* = P LE .05 ** = P LE .01 *** = P LE .001

Table C-44

Comparison of Phases II, III, IV and V On-Site and In-Depth Accidents with 1972-73-74 Monroe County Accidents by Driver's License

DRIVER'S LICENSE	ON-SITE		IN-DEPTH		MONROE COUNTY	
	N	O/O	N	O/O	N	O/O
LICENSED IN STATE OPERATORS, BEGINNERS, ETC.	3420	94.5	575	94.4	15108	94.6
RESIDENT OF STATE, NO LICENSE	50	1.4	7	1.1	115	.7
NON-RESIDENT	150	4.1	27	4.4	753	4.7
TOTAL	3620	100.0	609	100.0	15976	100.0
CHI-SQUARE	24.49***		1.66 NS		//////////////	

* = P LE .05 ** = P LE .01 *** = P LE .001

Table C-45

Comparison of Phases II, III, IV and V On-Site and In-Depth Accidents with 1972-73-74 Monroe County Accidents by Vehicle Type

VEHICLE TYPE	ON-SITE		IN-DEPTH		MONROE COUNTY	
	N	O/O	N	O/O	N	O/O
PASSENGER VEHICLE	3535	88.2	616	90.2	15201	86.3
TRUCK	421	10.5	63	9.2	2065	11.7
BUS	0	0.0	0	0.0	101	.6
MOTORCYCLE	44	1.1	2	.3	224	1.3
OTHER VECHICLE	8	.2	2	.3	21	.1
TOTAL	4008	100.0	683	100.0	17612	100.0
CHI-SQUARE	32.86***		15.62 **		//////////////	

* = P LE .05   ** = P LE .01   *** = P LE .001

Table C-46

Comparison of Phases II, III, IV and V On-Site and In-Depth Accidents with 1972-73-74 Monroe County Accidents by Status of Driver with Respect to Arrest

ARREST	ON-SITE N	ON-SITE 0/0	IN-DEPTH N	IN-DEPTH 0/0	MONROE COUNTY N	MONROE COUNTY 0/0
DRIVER NOT ARRESTED	2286	94.5	303	97.1	10167	89.5
ARRESTED FOR DRIVING UNDER THE INFLUENCE	48	2.0	1	.3	337	3.0
ARRESTED FOR OTHER VIOLATION	86	3.6	8	2.6	857	7.5
TOTAL	2420	100.0	312	100.0	11361	100.0
CHI-SQUARE	65.63***		19.64***		//////////////	

* = P LE .05 ** = P LE .01 *** = P LE .001

Table C-47

Comparison of Phases II, III, IV and V On-Site and In-Depth Accidents with National Estimates by Hour of Day

HOUR	ON-SITE		IN-DEPTH		U.S.[1]	
	N	0/0	N	0/0	N	0/0
MIDNIGHT TO 03:59AM	87	4.0	14	3.4	—	8.5
04:00AM TO 07:59AM	71	3.3	13	3.2	—	7.1
08:00AM TO 11:59AM	281	13.0	64	15.7	—	16.9
NOON TO 03:59PM	798	37.0	161	39.5	—	24.9
04:00PM TO 07:59PM	661	30.6	113	27.7	—	27.6
08:00PM TO 11:59PM	259	12.0	43	10.5	—	15.5
TOTAL	2157	100.0	408	100.0	—	100.0
CHI-SQUARE	264.79 ***		62.71 ***		//////////////	

* = P LE .05 ** = P LE .01 *** = P LE .001

[1] Accident Facts, 1974 Edition

Table C-48

Comparison of Phases II, III, IV and V On-Site and In-Depth Accidents with National Estimates by Urban and Rural Places

URBAN AND RURAL PLACES	ON-SITE		IN-DEPTH		U.S.[1]	
	N	0/0	N	0/0	N	0/0
RURAL AREA	754	35.0	164	40.3	—	27.9
URBAN AREA	1401	65.0	243	59.7	—	72.1
TOTAL	2155	100.0	407	100.0	—	100.0
CHI-SQUARE	53.83 ***		31.08 ***		//////////////	

* = P LE .05   ** = P LE .01   *** = P LE .001

[1] Accident Facts, 1974 Edition

Table C-49

Comparison of Phases II, III, IV and V On-Site and In-Depth Accidents with National Estimates by Severity of Accident

SEVERITY OF ACCIDENT	ON-SITE		IN-DEPTH		U.S.[1]	
	N	0/0	N	0/0	N	0/0
FATALITY	16	.8	7	1.7	—	.8
PERSONAL INJURY	541	25.4	116	28.6	—	36.4
PROPERTY DAMAGE	1570	73.8	282	69.6	—	62.8
TOTAL	2127	100.0	405	100.0	—	100.0
CHI-SQUARE	111.40 ***		14.07 ***		//////////////	

* = P LE .05 ** = P LE .01 *** = P LE .001

[1] National Accident Summary File, 1972 Statistics

Table C-50

Comparison of Phases II, III, IV and V On-Site and In-Depth Accidents with National Estimates by Accident Type

ACCIDENT TYPE	ON-SITE		IN-DEPTH		U.S.[1]	
	N	0/0	N	0/0	N	0/0
Single Vehicle	50.5	23.3	14.1	35.6	—	36.3
Multiple Vehicle	165.8	76.1	26.6	65.4	—	63.7
TOTAL	216.3	100.0	40.7	100.0	—	100.0
CHI-SQUARE	156.95	***	.48	NS	//////	//////

* = P LE .05 ** = P LE .01 *** = P LE .001

[1] Accident Facts, 1974 Edition

Table C-51

Comparison of Phases II, III, IV and V On-Site and In-Depth Accidents with National Estimates by Character of Location

CHARACTER OF LOCATION	ON-SITE		IN-DEPTH		U.S.[1]	
	N	0/0	N	0/0	N	0/0
INTERSECTION	451	50.6	48	47.5	—	40.6
Nonintersection	7098	50.8	233	57.2	—	59.4
TOTAL	2162	100.0	407	100.0	—	100.0
CHI-SQUARE	66.52	***	.78	NS	//////	//////

* = P LE .05   ** = P LE .01   *** = P LE .001

[1] Accident Facts, 1974 Edition

Table C-52

Comparison of Phases II, III, IV and V On-Site and In-Depth Accidents with National Estimates by Road Surface Condition

ROAD SURFACE CONDITIONS	ON-SITE		IN-DEPTH		U.S.[1]	
	N	0/0	N	0/0	N	0/0
DRY	1496	71.9	279	70.5	—	69.7
WET	494	23.7	98	24.7	—	21.0
SNOWY OR ICY	92	4.4	19	4.8	—	9.3
TOTAL	2082	100.0	396	100.0	—	100.0
CHI-SQUARE	62.10 ***		11.31 *		//////////////	

* = P LE .05 ** = P LE .01 *** = P LE .001

[1] Accident Facts, 1974 Edition

Table C-53

Comparison of Phases II, III, IV and V On-Site and In-Depth Accidents with National Estimates by Light Conditions

LIGHT CONDITIONS	ON-SITE		IN-DEPTH		U.S.[1]	
	N	0/0	N	0/0	N	0/0
DAYLIGHT	1555	74.5	315	79.1	—	63.2
DARKNESS	466	22.3	72	18.1	—	32.2
DAWN OR DUSK	66	3.2	11	2.8	—	4.6
TOTAL	2087	100.0	398	100.0	—	100.0
CHI-SQUARE	114.76	***	43.54	***	//////////////	

* = P LE .05 ** = P LE .01 *** = P LE .001

[1] National Accident Summary File, 1972 Statistics.

Table C-54

Comparison of Phases II, III, IV and V On-Site and In-Depth Accidents with National Estimates by Driver Sex

SEX	ON-SITE		IN-DEPTH		U.S.[1]	
	N	0/0	N	0/0	N	0/0
MALE	2601	66.9	431	65.7	—	71.9
FEMALE	1287	33.1	225	34.3	—	28.1
TOTAL	3888	100.0	656	100.0	—	100.0
CHI-SQUARE	48.15 ***		12.48 ***		//////////////	

* = P LE .05 ** = P LE .01 *** = P LE .001

[1] Accident Facts, 1974 Edition

Table C-55

Comparison of Phases II, III, IV and V On-Site and In-Depth Accidents with National Estimates by Driver Age

DRIVER AGE	ON-SITE		IN-DEPTH		U.S.[1]	
	N	0/0	N	0/0	N	0/0
UNDER 20	769	19.9	139	21.4	—	20.6
20 - 24	1129	29.2	203	31.2	—	18.8
25 - 34	809	20.9	140	21.5	—	21.3
35 - 44	409	10.6	66	10.2	—	14.1
45 - 54	354	9.2	65	10.0	—	11.9
55 - 64	209	5.4	17	2.6	—	7.9
OVER 64	183	4.7	20	3.1	—	5.4
TOTAL	3862	100.0	650	100.0	—	100.0
CHI-SQUARE	316.13 ***		92.26 ***		//////////////	

* = P LE .05 ** = P LE .01 *** = P LE .001

[1] Accident Facts, 1974 Edition

Table C-56

Comparison of Phases II, III, IV and V On-Site and In-Depth Accidents with National Estimates by Vehicle Type

VEHICLE TYPE	ON-SITE		IN-DEPTH		U.S.[1]	
	N	0/0	N	0/0	N	0/0
PASSENGER VEHICLE	3535	88.2	616	90.2	—	83.0
TRUCK	421	10.5	63	9.2	—	13.2
BUS	0	0.0	0	0.0	—	.6
MOTORCYCLE	44	1.1	2	.3	—	2.3
OTHER VECHICLE	8	.2	2	.3	—	1.9
TOTAL	4008	100.0	683	100.0	—	100.0
CHI-SQUARE	121.42	***	31.15	***	//////	//////

* = P LE .05   ** = P LE .01   *** = P LE .001

[1] Accident Facts, 1974 Edition

Table C-57

Comparison of Phases II, III, IV and V On-Site and In-Depth Accidents with National Estimates by Month of Accident

MONTH OF ACCIDENT	ON-SITE		IN-DEPTH		U.S.[1]	
	N	0/0	N	0/0	N	0/0
JANUARY THRU MARCH	575	27.0	110	28.9	2295	23.8
APRIL THRU JUNE	500	23.5	85	22.3	2207	22.9
JULY THRU SEPTEMBER	484	22.8	76	19.9	2436	25.2
OCTOBER THRU DECEMBER	567	26.7	110	28.9	2716	28.1
TOTAL	2126	100.0	381	100.0	9654	100.0
CHI-SQUARE	16.73***		8.51 *		//////	

* = P LE .05 ** = P LE .01 *** = P LE .001

[1] Monroe County Statistics, 1972-3-4 Indiana State Police Data

Table C-58

Comparison of Phases II, III, IV and V On-Site and In-Depth Accidents with National Estimates by Day of Week

DAY OF WEEK	ON-SITE		IN-DEPTH		U.S.[1]	
	N	0/0	N	0/0	N	0/0
SUNDAY	305	14.1	57	14.0	1362	14.1
MONDAY	321	14.8	69	16.9	1329	13.8
TUESDAY	282	13.0	75	18.4	1267	13.1
WEDNESDAY	325	15.0	64	15.7	1279	13.2
THURSDAY	362	16.7	57	14.0	1830	19.0
FRIDAY	334	15.4	45	11.0	1627	16.9
SATURDAY	237	10.9	41	10.0	960	9.9
TOTAL	2166	100.0	408	100.0	9654	100.0
CHI-SQUARE	17.37 **		26.93***		//////////////	

* = P LE .05 ** = P LE .01 *** = P LE .001

[1] Monroe County Statistics, 1972-3-4 Indiana State Police Data

Table C-59

Comparison of Phases II, III, IV and V On-Site and In-Depth Accidents with National Estimates by Weather Condition

WEATHER CONDITION	ON-SITE		IN-DEPTH		U.S.[1]	
	N	0/0	N	0/0	N	0/0
CLEAR	1605	77.3	299	75.1	6551	71.3
RAINING	355	17.1	80	20.1	1899	20.7
SNOWING	81	3.9	12	3.0	414	4.5
FOG	11	.5	1	.3	84	.9
OTHER	24	1.2	6	1.5	239	2.6
TOTAL	2076	100.0	398	100.0	9187	100.0
CHI-SQUARE	45.01***		6.59 NS		//////////////	

* = P LE .05 ** = P LE .01 *** = P LE .001

[1] Monroe County Statistics, 1972-3-4 Indiana State Police Data

Table C-60

Comparison of Phases II, III, IV and V On-Site and In-Depth Accidents with National Estimate by Driver's License

DRIVER#S LICENSE	ON-SITE		IN-DEPTH		U.S.[1]	
	N	0/0	N	0/0	N	0/0
LICENSED IN STATE OPERATORS, BEGINNERS, ETC.	3420	94.5	575	94.4	15108	94.6
RESIDENT OF STATE, NO LICENSE	50	1.4	7	1.1	115	.7
NON-RESIDENT	150	4.1	27	4.4	753	4.7
TOTAL	3620	100.0	609	100.0	15976	100.0
CHI-SQUARE	24.49***		1.66 NS		//////////////	

* = P LE .05 ** = P LE .01 *** = P LE .001

[1] Monroe County Statistics, 1972-3-4 Indiana State Police Data

Table C-61

Comparison of Phases II, III, IV and V On-Site and In-Depth Accidents with National Estimates by Status of Driver with Respect to Arrest

ARREST	ON-SITE N	ON-SITE 0/0	IN-DEPTH N	IN-DEPTH 0/0	U.S.[1] N	U.S.[1] 0/0
DRIVER NOT ARRESTED	2286	94.5	303	97.1	10167	89.5
ARRESTED FOR DRIVING UNDER THE INFLUENCE	48	2.0	1	.3	337	3.0
ARRESTED FOR OTHER VIOLATION	86	3.6	8	2.6	857	7.5
TOTAL	2420	100.0	312	100.0	11361	100.0
CHI-SQUARE	65.63***		19.64***		//////////////	

* = P LE .05 ** = P LE .01 *** = P LE .001

[1] Monroe County Statistics, 1972-3-4 Indiana State Police Data

APPENDIX D: FOCUSED EXAMINATION OF VEHICULAR CAUSAL FACTORS

The IRPS causal hierarchy is comprised of nine major vehicular causal factor categories. These categories relate to the systems of an automobile through which the driver receives information on his surroundings, initiates control commands, and communicates his intentions to other traffic units. These nine major categories are listed in Table D-1, which shows the frequency of identification of each factor category by phase. In the remainder of this section, the most frequently identified factors, and specifically those related to tires and brakes, will be more closely examined to determine the nature of the deficiencies, the reasons for their occurrence, and how they could have been prevented.[1]

Brake system factors were the most frequently identified vehicular factors. Among the characteristics of a properly functioning brake system are balanced braking from side-to-side; proper proportioning from front to rear (e.g., rears do not lock before fronts); ease of control (e.g., prompt response, but not overly-sensitive); and, full utilization of vehicle's tractive capability on wide range of road surface conditions.

Any braking system which did not meet all of the above criteria prior to an accident in which proper performance might have prevented or reduced the severity of the accident, was considered as a potential causal or severity increasing factor. During an IRPS in-depth vehicle inspection the automotive engineers routinely inspected the right front and left rear brake assemblies. They checked for proper assembly and operation of the brake mechanism and measured certain parameters such as lining thickness, drum diameter, and drum-lining clearance. These engineers also inspected for contamination of the brake lining material, which might cause unusual friction variations. If any deficiencies were found which might have been relevant to the accident, the remaining (left front and right rear) brake assemblies were also inspected. Evidence collected at the scene by the reconstruction specialist was also considered in making the final assessment of a braking deficiency. Phenomena such as severe yaw during braking, rotation, change of direction, and missing skid marks when others were present were all indicators of possible brake problems. Of course, information gathered from driver and witness interviews was also considered in making these assessments.

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[1]Minor differences in the classification of vehicular problems may be observed in comparison with the detailed data tables of Appendicies A & B. The present section was based on a re-examination of all cases by members of the engineering staff, leading to occasional differences of opinion in the classification of problems at lower levels of detail within the vehicle hierarchy.

Table D-1

Vehicle Causal Factors for Level C Frequency of Identification*

Vehicle Factors (Major Systems)	Phase II	III	IV	V	ALL
Tires & Wheels	8	1	3	5	17
Brake System	11	1	6	4	22
Steering System	3	1	0	0	4
Suspension	0	0	0	0	0
Power Train & Exhaust	0	0	1	0	1
Communication System	3	0	2	2	7
Driver Seating & Controls	0	0	0	1	1
Body & Doors	3	0	0	0	3
Other	0	0	0	0	0

*At the Certain or Probable, Causal or Severity Increasing Levels of Certainty and Significance

Brake system causal factors are subdivided into five categories, as shown in Table D-2, which indicates the number of accident cases identified at the "certain or probable" level of certainty and causal or severity-increasing level of significance.

Gross failure of a brake system was identified in ten accidents as a certain or probable, causal or severity-increasing factor (Table D-3). Gross failure is a loss of capability to actuate the brake mechanism of one or more wheels. Of the ten gross failure accidents, one was a right angle collision at an intersection; four were rear end collisions; and five were single vehicles that ran off the road and hit fixed objects at "tee" or "wye" intersections and dead ends of roads. In only three of the cases did the driver have enough time to down shift and apply the emergency brake, although only one driver actually downshifted. In the other cases, the driver had insufficient time to accomplish such actions. In one case, the single car accident at the "wye" intersection, steering input might have avoided the collision by directing the vehicle down one of the legs of the intersection, but use of the emergency brake would still have been required to stop the vehicle.

Seven of the gross failure accidents resulted in injury to one or more occupants of the vehicle. One of the non-injury accidents was a rear end collision involving gross failure of the front brakes only (there was some braking available from the rear brakes due to the vehicle being equipped with a dual chamber master cylinder). The other two non-injury accidents occurred at "tee" intersections and the driver in each case secured a measure of success in avoiding more serious injury by attempting to turn at the intersection. In one case the vehicle entered the ditch and rolled onto its side, and in the other the vehicle ran over a series of parking curbs in a parking lot before striking a tree, thus experiencing a relatively gentle stop compared to the other cases.

All but one of the failures could have been detected during Periodic Motor Vehicle Inspection (PMVI), provided that inspection of the particular failing component was required. Inspection is not presently required by Indiana law for any of the specific components which failed, although a driver can request that one wheel be removed to inspect brake components. Four of the failures might have been detected by simple visual inspection of brake components inside the brake drum if the mechanic selected the proper wheel, but there would have been a three in four chance that the deficiency would not have been discovered, since the problem existed in only one brake assembly. If all four

Table D-2

Brake System Factors (Level C) Frequency of Identification*

Brake Problem Category	PHASE II	III	IV	V	ALL
Brake System Factors	11	1	6	4	22
Gross Failure	5	0	1	4	10
Delayed Response (Pumping Required)	0	0	1	0	1
Imbalance	4	1	3	0	8
Grabbed or Locked Prematurely (Oversensitive)	0	0	1	0	1
Performance Degraded for Other or Unspecified Reasons	1	0	1	0	2

*At the Certain or Probable, Causal or Severity-Increasing Levels of Certainty and Significance

Brake System Gross Failure (Level C)

Table D-3

Phase	Case	Certainty	Make	Model	Year	Approximate age (years)	Mileage	Miles since last PMVI	Component that failed	Reason for failure	Assessed in current PMVI	Feasible to assess in PMVI	Front disc	Power assist	Injury	Type of collision	Could design change prevent	Evasive action attempted	Remarks
II	84	Cert	Ford	F-100 Panel Truck	60	11	90,043	——	Master cylinder sand in chamber	Neglected maintenance. Driver not aware of condition.	No	Yes	No	No	Yes	Rt.angle at cross intersection	No	None	
II	111	Prob	Chevrolet	3/4 ton truck	49	22	——	——	R.R.wheel cylinder over-extended. Total loss of brakes.	Neglected maintenance	No Opt.	Yes	No	No	Yes	Ran off dead end of road. Hit fixed object.	Yes	None	
II	133	Prob	Pontiac	LeMdns	63	8	64,970	9,075	All wheels excess clearance and insufficient lining thickness	Bad maintenance by mechanic and driver knew brakes were deficient	No* Opt.	Yes	No	No	Yes	Ran off road at wye intersection	Yes	None	*Note that driver knew of deficiency but continued to drive vehicle. Evasive steering could have prevented accident.
II	216	Prob	Dodge	Polara	68	4	53,274	4,198	Master cylinder out of round primary piston cup. Front brakes failed.	Manufacture defect	No	No	No	Yes	No	Rear end	No	None	
II	222	Cert/ SI	Chevrolet	Apache 10 P.U. Truck	61	11	64,486	1,097	L.R.wheel cylinder seized L.R.brake failed.	Neglected maintenance. Driver not aware of condition.	No Opt.	Yes	No	No	Yes	Rear end	No	None	
IV	68	Cert	Pontiac	Bonneville	66	7	42,398	634	R.F.brake hose ruptured. Total loss of brakes.	Neglected maintenance. Driver not aware of condition.	No	Yes	No	Yes	Yes	Ran off road at tee intersection	Yes	Steered around bus before leaving road	Down-shifting and use of emergency brake might have reduced severity

Table D-3 continued

Phase	Case	Certainty	Make	Model	Year	Approximate age (years)	Mileage	Miles since last PMVI	Component that failed	Reason for failure	Assessed in current PMVI	Feasible to assess in PMVI	Front disc	Power assist	Injury	Type of collision	Could design change prevent	Evasive action attempted	Remarks
V	177	Cert	Ford	Falcon	63	11	66,587	——	L.R.wheel cylinder failed due to loss of adjuster link and improper assembly	Bad maintenance. Improper assembly.	No Opt.	Yes	No	No	Yes	Rear end	Yes	None	
V	199	Cert	Chevrolet		55	19	94,689	5,836	L.F.brake hose cut by rubbing wheel rim	Improper assembly of system allowed contact on hard turns	No	Yes	No	No	Yes	Rear end	Yes	None	Use of emergency brake might have reduced severity
V	229	Cert	VW	Sedan	64	11	47,338	1,310	L.R.wheel cylinder over-extended due to improper adjustment	Neglected maintenance. Driver not aware of condition.	No Opt.	Yes	No	No	No	Ran off road at tee intersection	Yes	Attempted to turn corner	
V	238	Cert	Ford	Mustang	65	10	70,134	1,813	Rear brake hose ruptured due to rubbing modified exhaust system	Bad maintenance. Modified	No	Yes	No	No	No	Ran off road at tee intersection	No	Attempted to turn corner	

wheels were removed to permit inspection of each of the brake assemblies and if a visual check of all brake hoses and pipes were made, then eight of these ten accidents might have been avoided. The ninth accident (case 84 of Phase II) probably could also have been avoided if the inspecting mechanic had examined the master cylinder reservoir for sludge or other contaminants. The tenth case would have required complete teardown of the master cylinder and therefore would probably have escaped detection under most known inspection procedures.

Indiana currently does not require such a thorough inspection as described above, presumably because it would make the inspection more expensive and time-consuming. In addition, it is probably not necessary for newer cars. None of the vehicles experiencing gross brake failure had less than 42,000 miles on the odometer. Only two had less than 50,000 miles. Of those with functioning odometers, the average mileage was 65,991 miles. This observation suggests that a one-time, thorough inspection at 50,000 miles might be desirable. Under this plan seven of the ten brake system gross failures might have been prevented.

Various parts were responsible for the brake failures which were discovered. There were three brake hose failures, three wheel cylinder failures, two master cylinder failures, one general system failure involving all four brake assemblies, and one automatic adjuster failure.

The brake hose failures all occurred in vehicles with single chamber master cylinders, and resulted in total loss of the service brake systems. The first is case 68 of Phase IV. It was a 1966 Pontiac Bonneville with 43,298 miles on its odometer, approximately seven years old at the time. This vehicle had been inspected under Indiana PMVI just 634 miles prior to the accident. The right front brake hose ruptured at its junction with its metal end due to drying and cracking of its outer rubber skin. The chord plies were exposed to the elements and eventually weakened and ruptured. A simple visual inspection of the brake rubber hoses (not required by Indiana inspection law) would have detected the brittle, cracked rubber and would have prevented this accident.

The second brake hose failure was case 199 of Phase V. The vehicle was a 1955 Chevrolet with 94,687 miles on its odometer, approximately 19 years old at the time of the accident. The left front brake hose was cut by the inner rim of the left front wheel. The wheel and hose came into contact only during left turns. The right side brake hose was similarly cut during right turns. This failure was not necessarily related to the age and mileage of the vehicle.

The owner was not the original owner and did not know whether the hoses were original equipment or if they had been repositioned during work on other parts. The hoses were in good condition which suggests that they were not nineteen years old, and were positioned with an upward loop instead of a downward loop which would have protected the hose. So, it appears that this failure was caused by improper reassembly of the system. This vehicle had been inspected seven months prior to the accident and had been driven 5,836 miles since inspection. The IRPS automotive engineers could not determine how rapidly this condition had developed, so there is little confidence that requiring inspection of brake hoses would have prevented this failure; it could have developed after inspection in a very short time.

The third brake hose failure was case 23 of Phase V. The vehicle was a 1965 Ford Mustang with 70,134 miles on its odometer, approximately ten years old. The rear brake hose, located near the differential, was abraded by contact with a modified exhaust system. This make and model of vehicle was originally equipped with a transversely mounted muffler located behind the rear axle. The accident-involved vehicle, however, had been equipped with a longitudinally mounted muffler and an apparently hand fabricated tail pipe which interferred with the brake hose just above the rear axle. This vehicle had been purchased from a used car dealer and had been inspected, as required, at the time of purchase. The new owner had driven the vehicle 1,813 miles and was unaware that the exhaust system was not standard. Had the inspecting mechanic been required by Indiana PMVI rules to inspect the brake hoses, this accident would probably have been prevented.

The three wheel cylinder failures generally involved isolated deficiencies of only one wheel assembly. They all occurred in vehicles with single chamber master cylinders and three of the failures resulted in complete loss of the service brake system. The first wheel cylinder failure was case 111 of Phase II. The vehicle was a 1949 Chevrolet 3/4 ton truck with mileage unknown. The right rear wheel cylinder overextended upon hard application of the brakes and hydraulic pressure was lost. The reason for the overtravel of the wheel cylinder piston was lack of periodic adjustment of the brakes to compensate for wear coupled with probable thermal expansion of the brake drum. Since the mileage on this vehicle since its last PMVI was unknown and since the failure was directly related to wear, the IRPS automotive engineers could not determine to a high degree of certainty whether this failure would have been detected by a careful examination and measurement of all four brake assemblies. However, assuming average use of approximately 10,000 miles annually, brake shoes would generally not wear to such an extent that the wheel cylinder piston would travel out of the wheel cylinder over a twelve month period. Therefore, it is possible that excess drum to lining clearance existed in the vehicle ten months before the accident, when it was inspected, and the inspector could have discovered this condition by measuring the lining and drums.

The second wheel cylinder failure was case 222 of Phase II. The vehicle was a 1961 Chevrolet Apache 10 truck with 64,486 miles on its odometer, approximately eleven years old. The left rear wheel cylinder was frozen and would not activate the left rear brake. This failure was determined to be a severity increasing factor rather than a causal factor, since the remaining brake assemblies still functioned; the additional braking would probably not have prevented the accident. The driver was apparently unaware of the condition. The vehicle had been inspected five months prior to the accident and had been driven 1,097 miles since being inspected. New brake shoes had been installed "within six months" of the accident, but the case file did not indicate whether the brakes were serviced before or after the vehicle was inspected. This failure was caused by improper maintenance in that the mechanic did not rebuild the wheel cylinders, as is normally recommended, at the time the brake shoes were replaced. The inspecting mechanic might have detected the problem through a comprehensive road test or a brake dynamometer test. Visual inspection, however, might not have been enough in this case because the linings and drums probably showed no signs of wear or maladjustment.

The third wheel cylinder failure was case 299 of Phase V. It involved a total brake failure in a 1964 Volkswagen sedan with 47,338 miles on it and approximately eleven years old. The vehicle experienced a total loss of its brake system due to a failure of its left rear wheel cylinder. Lack of periodic adjustment for wear of the brake linings and slight corrosion in the wheel cylinder resulted in a catastrophic leak. If the car had been equipped with automatic adjusters, the excessive drum to lining clearance might not have developed, but the corrosion in the cylinder might still have eventually caused a serious leak. A dual chamber master cylinder certainly would have prevented a total loss of the brake system pressure. This vehicle had been inspected 1,310 miles previous to the accident. Proper inspection techniques could have revealed the excess clearance and the need for adjustment, but the internal corrosion in the wheel cylinder probably could not have been discovered.

The two master cylinder cases involved both a vehicle with a single chamber master cylinder and one with a dual chamber master cylinder. The first case was number 84 of Phase II. It involved a 1960 Ford panel truck which was approximately 11 years old at that time with 90,043 miles on its odometer. Sand in the master cylinder caused the entire braking system to suddenly fail. The vehicle was approaching an intersection with a "Stop," sign, which it ran, and was subsequently struck in the side by a passenger car.

Obviously, the preventive measure for the above problem is to keep sand and other contaminants out of the hydraulic system. However, in consideration of the low frequency of this particular problem and the high probability that probing for contamination in the master cylinder reservoir might introduce contamination, periodic inspection is not likely to be beneficial.

The second master cylinder case was number 216 of Phase II. It was a 1968 Dodge Polara with 53,274 miles on its odometer. The vehicle was equipped with power assisted dual chamber master cylinder brakes. The piston cup which operated the front brakes was out of round, causing an intermittent failure of the front brakes, although the rear brakes still functioned. This car rear ended another car. A close inspection of the master cylinder piston revealed no evidence of damage or deterioration of the piston cups other than an out of round condition, which was possibly a manufacturing defect. The front brakes failed twice during six test stops conducted by the IRPS mechanic. The owner was a conservative driver who had never noticed any brake problems prior to the accident.

One gross failure was attributed to overall poor condition of the entire brake system. Case 133 of Phase II involved a 1963 Pontiac Lemans with 64,970 miles on its odometer, approximately 8 years old at the time of the accident. Excess drum to lining clearance at three wheels and zero lining thickness on all four wheels permitted only very moderate braking effort. During normal, moderate driving, the brake pedal traveled almost to the floor and there was insufficient remaining travel to develop enough pressure for maximum braking. In addition, all of the linings were worn to the rivets so that, even with adequate system pressure, the braking performance would have been degraded.

Table D-3 summarizes selected facts about the brake system gross failure cases.

Imbalanced braking from side-to-side was the second most frequently identified brake system factor at the certain or probable, causal or severity-increasing level.

There were eight cases identified at this level, and three additional cases at the possible level of certainty (Table D-4).

Of the "certain or probable" cases, four were situations where the subject vehicle swerved or pulled during braking and traveled into the path of an oncoming traffic unit. The other four cases are quite similar in that the vehicles swerved or rotated during braking, but merely ran off the road, there being no oncoming cars. Each of the drivers either did not attempt to steer, or did so after they had already locked the brakes, so that there was no vehicle response to steering. Locked wheel braking was unnecessary in these accidents as there was an easily-attainable escape route or there was no serious danger of collision in the first place. It appears that the need for firm, but not panic, braking arose and the drivers either mistakingly interpreted the situation or were incapable of modulating the brakes properly; or upon the unintentional initiation of a slight skid, the surprised drivers did not have the presence of mind to do anything but brake harder. In one case, the driver refrained from locked wheel braking but made no corrective steering inputs as the car veered into the path of an oncoming car; while it is possible that the brake imbalance was so great that the driver could not overcome it, he did not recall making any such effort.

Two of the three "possible" level cases required maximum braking to avoid rear end collisions. One resulted in an opposing oblique collision with an oncoming car. In another case, the subject vehicle ran off the road and rolled over. The third accident occurred during icy conditions. It may have been beyond the capability of any driver to modulate braking under such conditions, but a slight braking imbalance existed which possibly contributed to rotation prior to leaving the road.

Eight of the eleven "certain, probable, or possible" brake imbalance cases were caused by neglected maintenance, two by improper maintenance by the owners, and one by improper maintenance by a professional mechanic. Overall, nine of the drivers definitely knew of the deficiency in brake performance in their vehicles prior to their accidents, and the other two possibly knew but did not admit it. This leads to serious doubt as to whether built-in warning devices would have changed the outcome of these accidents.

Four of these eleven accidents caused injury to at least one person. Only one of the injury producing accidents was a collision with another car. In that collision, the two vehicles collided at right angles after approaching from opposite directions. None of the opposing oblique type

Brake System Imbalanced Braking (Level C)

Table D-4

Phase	Case	Certainty	Make	Model	Year	Approximate age (years)	Mileage	Miles since last PMVI	Component that failed	Reason for failure	Assessed in current PMVI	Feasible to assess in PMVI	Front disc	Power assist	Injury	Type of collision	Could design change prevent	Evasive action attempted	Remarks
II	113	Poss	Olds-mobile	Cutlass	67	4	55,681	11,931 (two months over-due)	L.R. lining thickness 0/32" when other rear was 3/32"	Neglected Mainte-nance. Owner knew of problem.	No Opt.	Yes*	No	No	No	Opposing oblique	Yes	Steered and locked brakes	*Note that owner knew of problem but continued to drive vehicle. Proper steer-ing and re-fraining from locked wheel braking might have prevent-ed accident.
II	136	Cert	Chev-rolet	2-door sedan	55	17	112,620	13,871	R.F. lining contami-nated due to wheel cylinder leak. R.R. lining contami-nated due to bearing seal leak.	Neglected mainte-nance.	No Opt.	Yes	No	No	No	Opposing oblique	No	Braked only did not lock	Vehicle pulled left into path of oncoming car. Driver should have steered right.
II	214	Prob	Pon-tiac	Tempest	68	4	81,201	13,286	R.F. badly worn, drum 0.200" oversize; 0/32" lining thickness; 0.250" drum to lining clear-ance	Neglected mainte-nance. Driver knew of defi-ciency.	No Opt.	Yes*	No	No	No	Ran off road during attempted stop on straight road	Yes	Locked wheels	Driver should have refrain-ed from locked wheel braking, as it was not necessary to avoid collision. *Note that driver knew of defi-ciency.

Table D-4 continued

Phase	Case	Certainty	Make	Model	Year	Approximate age (years)	Mileage	Miles since last PMVI	Component that failed	Reason for failure	Assessed in current PMVI	Feasible to assess in PMVI	Front disc	Power assist	Injury	Type of collision	Could design change prevent	Evasive action attempted	Remarks
II	225	Cert	Chevrolet	Chevelle	69	3	61,063	4,277	R.F. lining and rivets completely worn away. L.R. worn to rivets.	Neglected maintenance. Driver knew of deficiency.	No Opt.	Yes*	No	No	No	Ran off road and rolled over after attempting to slow for stopped car	Yes	Braked hard	Brakes pulled to right. *Note that driver knew of deficiency but continued to drive vehicle.
II	227	Cert	Chevrolet	Impala	68	4	53,203	2,716	R.F. lining worn to metal shoe and L.R. drum to lining clearance excessive.	Neglected maintenance	No Opt.	Yes	No	Yes	Yes	Right angle after rotating 90° and crossing center line during locked wheel braking to avoid a dog	Yes	Braked hard	Should have refrained from braking hard and steered onto shoulder
III	45	Prob	Plymouth	Belvedere	66	7	32,435 (inoperable)	unknown (7 months)	L.F. lining worn to metal. R.F. new.	Improper maintenance by owner/driver who knew of deficiency	No Opt.	Yes*	No	No	No	Ran off road after rotating during attempted stop on straight roadway	Yes*	Braked hard when unnecessary	*Note that owner/driver performed improper maintenance and probably would have ignored any warning devices or PMVI requirements
IV	106	Cert	Oldsmobile	Cutlass	68	5	63,131	17,633	R.F. lining worn to metal shoe, drum badly scored, drums on front mismatched. L.F. lining worn to rivets. Drum non-stock finned drum.	Improper maintenance by professional mechanic and neglect by owner as he knew of deficiency.	No Opt.	Yes*	No	Yes	No	Opposing oblique car pulled left into opposing lane on braking for slowing traffic ahead.	Yes	Braked hard	*Note that owner/driver knew of problem's existence but continued to drive car.

Table D-4 continued

Phase	Case	Certainty	Make	Model	Year	Approximate age (years)	Mileage	Miles since last PMVI	Component that failed	Reason for failure	Assessed in current PMVI	Feasible to assess in PMVI	Front disc	Power assist	Injury	Type of collision	Could design change prevent	Evasive action attempted	Remarks
IV	127	Prob	Dodge	Challenger	70	4	61,056	2,950	Contaminated L.F. lining due to hub seal leak	Neglected maintenance. Owner/driver knew of deficiency.	No Opt.	Yes*	No	No	Yes	Ran off road after nearly losing control in turn, brakes pulling left prevented recovery	No	Braked and steered. Hard braking unnecessary.	Other serious deficiencies also existed. *Note that owner knew of problem
IV	136	Prob	Chevrolet	Camaro	69	5	49,635 (inoperable)	unknown (12 months)	Unevenly worn front disc brake pads car pulls left	Neglected maintenance. Owner/driver knew of deficiency.	No Opt.	Yes*	Yes	Yes	Yes	One car ran off road during attempt to slow	Yes	Braked hard when unnecessary	*Note that owner knew about pulling condition, but continued to drive vehicle
V	197	Poss	Pontiac	Grand Prix	63	11	72,882	1,155	Vehicle pulled right. Both front linings worn to rivets. R.F. brake locked.	Neglected maintenance Owner/driver knew of deficiency.	No Opt.	Yes*	No	Yes	Yes	One car ran off road during attempt to slow	Yes*	Braked hard when unnecessary	*Note that owner knew about deficiency, but continued to drive vehicle
V	248	Poss	Mercury	Montego	73	2	29,914	5,197	Excess drum to lining clearance on L.R.	Improper maintenance by owner. Auto adjuster improperly assembled.	No Opt.	Yes*	Yes	Yes	No	One car ran off road during attempt to slow on icy pavement	No	Braked	Imbalance was probably very slight, but possibly significant due to icy conditions. *Note that owner was responsible for problem and performed improper maintenance after last PMVI

collisions (typically, sideswipe or corner impacts) caused injuries. Apparently, vehicle occupants were spared injury by virtue of low collision acceleration levels inherent in the collision configuration and by virtue of significant braking having taken place prior to collision (indeed, braking is necessary for significant deviation due to brake imbalances to take place). The remaining injury-producing cases involved collision with fixed objects after the subject vehicles left the roadway.

Excessive wear of the brake linings (permitting metal-to-metal contact) was the primary cause of brake imbalance, occurring in eight of the eleven cases. Contamination of the lining material was second in importance, causing two of the brake imbalance problems. Excessive drum to lining clearance was possibly responsible for one accident.

The average mileage for the vehicles with excessive lining wear was 64,527 miles. The vehicle with the least indicated mileage had 32,432 miles on its odometer, which was inoperative (the same mileage was shown on the vehicle's seven month old inspection sticker). The next lowest mileage was 49,635 miles, but this vehicle also had an inoperative odometer. Those vehicles with operating odometers all had over 50,000 miles.

The lining contaminations were caused by both hub seal leaks and wheel cylinder leaks. Front and rear hub seals were responsible for one lining contamination each, and one front wheel cylinder was also responsible for a contaminated lining.

Power assisted brake systems were present in five of the eleven imbalanced braking vehicles, and cases of the driver braking harder than necessary occurred four times with power assist and four times without.

Table D-4 summarizes selected facts about the imbalanced braking cases.

Brakes grabbed, locked prematurely, or were oversensitive is the next-ranking brake system subcategory in importance. Four cases were determined to be in this category (Table D-5). In the first of these cases (Case 131, Phase II), a rear-engine vehicle slid off the outside of a sharp right curve of decreasing radius, on wet pavement, with all four wheels locked. Her husband had adjusted the brakes the day before, leaving no clearance. The control loss was initiated with an initial lock-up of the rear wheels and resultant fish-tailing, followed by locking of all four wheels and a slide off the road in a straight-ahead, tracking attitude. The extreme sensitivity of the brakes in this condition was listed as a possible causal factor.

Brake System Grabbed, Locked or Oversensitive (Level C) — Table D-5

Phase	Case	Certainty	Make	Model	Year	Approximate age (years)	Mileage	Miles since last PMVI	Component that failed	Reason for failure	Assessed in current PMVI	Feasible to assess in PMVI	Front disc	Power assist	Injury	Type of collision	Could design change prevent	Evasive action attempted	Remarks
II	131	Cert	VW	Sedan	63	8	71,371	unknown	Zero drum to lining clearance caused brakes to grab	Improper maintenance, manually overadjusted. Owner did not know of extreme sensitivity.	No Opt.	Yes*	No	No	Yes	Ran off road on curve on wet pavement	Yes	Released brakes and steered to reduce spin	Vehicle vaulted, large drop, over bridge header wall. *Manual adjustment of brakes took place day of accident.
II	144	Cert	Plymouth	Fury II	71	1	22,557	22,556	R.R. brake locked before others.	Unknown	No	No*	Yes	Yes	Yes	Ran off straight road while attempting slow after passing	No	Steered and braked	*Dynamic brake test machine only could detect problem. Driver unfamiliar with power brakes.
II	225	Cert	Chevrolet	Chevelle	69	3	61,063	4,277	Premature lock up of rear brakes due to fronts worn to rivets	Neglected maintenance. Owner knew of problem.	No Opt.	Yes*	No	No	No	Ran off road, rolled over after attempting to slow for stopped car	Yes*	Braked hard	*Note that driver knew of deficiency, but continued to drive vehicle.
IV	79	Prob	International	1200 truck	64	9	105,559	779	Oversensitive rear brakes	Inherent design problem. Large brakes required for loaded vehicle are too strong for empty condition.	No	No	No	No	No	Opposing oblique on straight road	Yes	Braked hard	Wet road and bald tires contributed to brake sensitivity

In case 144 of Phase II, the vehicle went into a clockwise rotation, slid off the right side of a straight road section, and rolled over, following a sharp braking action and steer to the right (dry pavement), as the driver tried to abort a passing maneuver and return to her own side of the road. The right rear locked prematurely, playing a critical role in her loss of control. The tendency to rear wheel lock-up was confirmed in test drives and on a dynamic brake tester.

In Case 225 of Phase II, the vehicle went into a clockwise rotation and ran off the right side of a straight road, rolling-over, when the driver attempted to slow for a stopped car. Only the rear wheels locked, leading to the loss of control. In addition, the front brakes were imbalanced, generating a significant pull to the right, as a result of the front linings being worn down to the rivets, which had scored the drum considerably. Brake problems were considered a certain causal factor.

Case 79, Phase IV, was an opposing oblique collision occurring when the driver of the subject vehicle, an empty pick-up truck, attempted to stop on a rain slickened street (7.5% downgrade) and the vehicle rotated more than 180° due to the rear wheels locking unexpectedly. The rear-wheel lock-up was considered a probable causal factor.

The reasons behind the malfunctions in this category are slightly more difficult to sort out than in previous categories because environmental factors, human factors, and other vehicle factors are intermixed in these cases. Case 131, Phase II, involved a 1963 Volkswagen sedan with 71,371 miles on its odometer and approximately eight years old. The front tires were marginal. Their tread depths in inches were; left front, 2/32, 2/32, 0/32 (inside, middle, and outside, respectively); right front, 2/32, 3/32, 0/32. The roadway was wet and there was negative superelevation on a curve, which reduced the braking μ to an estimated 0.30. The brakes had been adjusted that day to zero drum to lining clearance and the driver was not familiar with their extreme sensitivity. As the vehicle rounded a curving approach to the bridge, the driver applied the brakes, causing the vehicle to travel in a tangent path for a short distance. The driver released the brakes but the vehicle was too near the header wall to complete the curve.

Case 79 of Phase IV was similar in several respects. The vehicle was a 1964 International 1200 pick-up truck with 105,559 miles on its odometer and approximately nine years old. This vehicle's rear tires were excessively worn; they were smooth except for the remains of snow tread lugs on the shoulder only. The street was slippery due to rain and a significant downgrade in the direction of travel (μ was measured at 0.25). The driver had not driven the vehicle in the rain before and therefore was not familiar with the sensitivity of its rear brakes. Such sensitivity is a problem in many trucks when empty. Trucks are often intended to carry loads which approach the weight of the vehicle alone. Therefore, the vehicle must have brakes which are powerful enough to safely stop the vehicle under maximum load conditions. When empty, however, the rear brakes are easily locked. Wet roads, a downgrade, and bald tires magnify the tendency to lock the rear wheels. The driver applied the brakes well in advance of an intersection, but the rear wheels locked, causing the vehicle to rotate and strike a parked car.

Case 144, as described above, involved a 1971 Plymouth Fury II with 22,757 miles on the odometer. It was approximately one year old at the time of the accident. The right rear wheel lock-up was confirmed through both driving tests and dynamic testing, although the specific reasons were not able to be determined. In stops from 60 mph, a 25 pound pedal load locked the right rear, although a load of 35 lbs. was required to lock the left rear.

The remaining case, number 225 of Phase II, involved a 1969 Chevrolet Chevelle with 61,063 miles on its odometer, approximately three years old at the time. This vehicle ran off the road and turned over after the driver attempted to slow for a stopped car ahead. The rear brakes locked significantly before the front brakes and the car rotated approximately ninety degrees as it ran off the road and rolled over. This vehicle had experienced pulling to one side during braking prior to the accident and the driver was well aware of the condition. Built in warning devices and wear indicators probably would not have helped, because the owner knew of the problem but did nothing.

Table D-5 summarizes selected facts about this category of brake deficiencies.

Performance degraded for other or unknown reasons is the next brake system subfactor. Two cases were identified at the certain or probable, causal or severity-increasing level (Table D-6). In addition, there were six cases at the possible level. This category included vehicles which had less than full braking capability, although some braking effect was available at each wheel. Some of the deficiencies would normally cause an imbalance condition, but these vehicles did not deviate from their paths nor rotate appreciably. Degradations in performance are difficult to identify and their effect is even more elusive. Unlike gross failure, which is either present or absent, degradations may

Brake System Performance Degraded (Level C)

Table D-6

Phase	Case	Certainty	Make	Model	Year	Approximate age (years)	Mileage	Miles since last PMVI	Component that failed	Reason for failure	Assessed in current PMVI	Feasible to assess in PMVI	Front disc	Power assist	Injury	Type of collision	Could design change prevent	Evasive action attempted	Remarks
II	82	Prob/SI	Plymouth	Baracuda	65	6	54,274	4,859	L.R.wheel cylinder leak caused contaminated lining	Neglected maintenance. Driver did not know of condition.	No Opt.	Yes	No	No	No	Rear end	No	Braked hard only	
II	158	Poss	Chevrolet	Impala	63	8	94,595	7,658* (one month overdue)	Front brakes insufficient lining thickness. R.F.drum barrel shaped wear.	Neglected maintenance. Driver did not know of condition.	No Opt.	Yes*	No	No	No	One car ran off road at end of curve	Yes*	Braked hard	*Note that inspection was one month overdue
IV	98	Poss	Ford	Falcon	60	13	93,191	674	Excess clearance in both front. Contaminated R.F. due to wheel cylinder leak.	Neglected maintenance. Driver did not know of condition.	No Opt.	Yes	No	No	Yes	Rear end	No	Braked hard only	
IV	112	Poss	Ford	F-100 Truck	65	8	107,232	1,321	Excess clearance 3 brakes. Both front severely contaminated due to wheel cylinder leaks.	Neglected maintenance. Owner knew of deficiency.	No Opt.	Yes*	No	No	Yes	Rear end	No	Braked hard only	*Note that driver knew of problem but continued to drive vehicle. Should have steered.
IV	122	Poss	Chevrolet	Apache 10 Truck	60	14	69,263	2,843	Excess clearance R.F. Extreme contamination both rears due to hub seal leaks.	Neglected maintenance. Owner knew of deficiency.	No Opt.	Yes*	No	No	No	Ran off road while trying to slow for vehicle sliding in front of subject vehicle on ice	No	Braked and steered	*Note that owner knew of deficiency but continued to drive vehicle

Table D-6 continued

Phase	Case	Certainty	Make	Model	Year	Approximate age (years)	Mileage	Miles since last PMVI	Component that failed	Reason for failure	Assessed in current PMVI	Feasible to assess in PMVI	Front disc	Power assist	Injury	Type of collision	Could design change prevent	Evasive action attempted	Remarks
IV	154	Prob	Dodge	Charger	68	6	62,792	26,213	Cont.L.R. lining due to wheel cylinder leak. 0/32" lining thickness. Possible air in system. No fluid in res. Warning light burned out.	Neglected mainte-nance. Owner knew of problem.	No Opt.	Yes*	No	No	Yes	Rear end	Yes*	Braked hard, pumped, steered	*Owner knew of problem but continu-ed to drive vehicle
V	200	Poss	Chev-rolet	Cor-vette	66	8	50,803 (inop-era-tive)		Air in lines and contami-nated R.R.pads	Improper mainte-nance by mechanic. Owner did not know of problem.	No Opt.	Yes	Yes (all)	No	Yes	Rear end	No	Braked hard	Mechanic had installed common bolt in place of R.R.cylinder bleeder screw.Leaked badly.
V	263	Poss SI	Chev-rolet	Belair	61	14	97,351	891	Lining contami-nated due to hub seal leak	Neglected mainte-nance. Owner knew of problem.	No Opt.	Yes*	No	No	No	Rt.angle	No	Braked and steered	*Note that owner knew of problem but continued to drive vehicle

occupy the continuum in between. Consequently, these factors are generally cited at the lower levels of certainty. A full range brake dynamometer is a definite asset to this area of vehicle factor evaluation.

Five of the accidents were rear end type collisions. Two were single vehicles which ran off the road while attempting to slow. One of the ran-off-the-road accidents was on exceptionally slippery ice and it may have been true that if the vehicle had optimum brakes, the accident would have happened anyway. One of the accidents was a right angle collision. Four accidents were injury producing, all of which were rear-end type accidents.

The average mileage for those vehicles with functioning odometers was 82,775 miles. The average age (approximated by subtracting the model year from the year in which the accident took place) was 9.6 years. The components which failed or which were deficient had received little or no maintenance in all but one case.

Case number 200 in Phase V had received improper maintenance by a professional mechanic. Air had entered the right rear wheel cylinder and fluid had leaked from the cylinder due to a bleeder screw having been replaced by a common bolt. The brake disk and pads on the right rear were badly contaminated.

Five of the vehicles had one or more contaminated brake linings due to wheel cylinder leaks, two had contaminated linings due to hub seal leaks, and one had degraded brakes due to excessive wear of linings and drums. Half of the owners did not know of the deficiency in their vehicles or knew but did not admit it. The other half definitely knew their vehicles had poor brakes.

All of the contamination problems and certainly the excess wear problem could have been detected by inspection of the brake assemblies. A warning device for excessive wear could be a mechanical screecher that would make a distinct noise by contacting the drum when the lining thickness reached a minimum value. Or, electric contacts inbeded in the lining material could activate a warning light when the lining wear becomes critical. A warning device for contamination might be more difficult to construct. Chemical sensitive switches or crystals might be utilized. A simpler solution might be better oil slinger arrangements to trap or expel oil and grease from hub seal leaks. For wheel cylinder leaks in drum brakes, the piston boots could be equipped with a drip tube which extends outside the brake backing plate. On the other hand, proper periodic inspection and maintenance should make all the above devices unnecessary.

Table D-6 summarizes selected facts about cases with brake system "performance degraded" factors.

Tires and wheels ranked second among vehicle factors identified at the certain or probable and causal or severity-increasing level of certainty and significance. Seventeen such cases were identified (Table D-7). Although the tires and wheels system category was divided into six subcategories, the preponderance of the cases fell into only two of the subcategories, inflation deficiencies and inadequate tread depth. Inflation deficiencies were identified at the certain or probable level in eight cases and listed as possible causes in eleven cases. Tread depth deficiencies were identified at the certain or probable level in eleven cases and seven cases were listed at the possible level of certainty (one case tabulated at the probable level was listed "possible-causal" and "probable-severity increasing"). No blow-outs were identified in 420 accidents investigated by the in-depth team. Table D-7 shows the six subcategories of Tires and Wheels problems and their frequencies of identification.

Tires and wheels, as a properly functioning vehicle system, should provide balanced traction from side-to-side and front-to rear; good traction on both wet and dry pavement; adequate support with proper tire-road contact; and, stable and balanced dynamic behavior.

The IRPS engineers sought to determine whether the tire-wheel system of an accident-involved vehicle was a properly functioning system just prior to the accident and if not, whether correction of an observed problem would have prevented the accident or reduced its severity. To do this, the engineers measured tire pressures and tread depths and recorded tire carcass types, tread types, and tire sizes. Scene data (physical evidence) and interview data were also very important in determining the relevance to the accident of any deficiencies noted during inspection.

Inflation pressure was considered defective, for purposes of IRPS post-crash vehicle inspection, if it was four pounds per square inch over or under the manufacturer's recommended maximum or minimum pressure, respectively, for the load conditions and tires on the vehicle.

However, for the purposes of accident causation assessment, the defect was not listed as a causative vehicle factor unless there was further evidence of the deficiency actually adversely affecting vehicle performance and the outcome of the accident, as assessed by the multidisciplinary team.

Table D-7

Tires and Wheels Factors (Level C) Frequency of Identification*

Phase	II	III	IV	V	ALL
Tires and Wheels	8	1	3	5	17
Inflation	7	0	0	1	8
Tread Depth	5	0	2	4	11
Blow-Out	0	0	0	0	0
Mixed Types and Sizes	0	0	0	0	0
Wheel Loss or Failure	0	0	1	0	1
Other	0	1	0	0	1

*At the Certain or Probable, Causal or Severity-Increasing Levels of Certainty and Significance

Of the nineteen cases cited as "certainly, probably, or possibly" involving improper inflation as a causal or severity-increasing factor, 15 involved underinflation (four involved front tires, seven involved rear tires, and four involved a mixture of fronts and rears); three involved overinflation (two involved front tires, one a mixture of fronts and rears); while the remaining case involved a variance between RF and LF tires (Table D-8).

Underinflation of front tires usually causes understeer or reduction of the vehicle's response to steering inputs. Thus, in understeer a car might slide front end first off the road to the outside of a turn. In other cases, the car might skid off the road to the outside of a turn, but then the driver might steer to regain the roadway and overcorrect, causing the vehicle to travel back across the road and crash on the inside of the turn. Of the nineteen possible inflation cases, 3 involved clear understeer symptoms; these constituted three out of the four cases of underinflated front tires. The fourth case was similar, involving "poor steering response" due to underinflated front tires.

Underinflation of rear tires, on the other hand, generally causes oversteer or a tendency for a car to exaggerate reaction to steering inputs. In the extreme, oversteer causes a vehicle to rotate uncontrollably toward the inside of a turn. Quite often, it is beyond the skill or capability of the driver to correct for an oversteer once it is initiated. Even in milder situations it is somewhat unnatural to steer toward the outside of a turn and drivers sometimes make no attempt to recover from an oversteer skid.

Of the fifteen "possible" underinflation cases, seven involved underinflated rear tires, and each of these contributed to accident involvement due to increased oversteer tendencies. Of four additional cases involving a mixture of underinflated fronts and rears, two resulted in oversteer problems (i.e., 9 clear over steer cases, altogether).

Overinflation of a tire reduces the tire-road contact patch and thus decreases traction in most instances, as well as reducing the slip angle for a given cornering force. Three cases of the nineteen (16%) in the inflation category involved excessive tire pressures.

Six of the cases involved a single vehicle running off the road on a curve. The remaining cases involved loss of control during rather abrupt maneuvers to (a) avoid other vehicles; (b) regain the roadway after slipping off of the pavement; or (c) to regain the travel lane after passing. Eleven of the cases, or 58%, involved injury to at least one

Tires and Wheels, Inflation Problems

Table D-8

Phase	Case	Certainty	Make	Model	Year	Approximate age (years)	Mileage	Miles since last PMVI	Component that failed	Assessed in current PMVI	Could design change prevent	Injury	Type of collision	Evasive action attempted	Remarks
II	112	Prob	Pontiac	Tempest	62	9	121,861	unknown	L.F.tire 11/24 caused understeer	No	No	No	Ran off straight road	Over-corrected to regain right lane from left lane	Wet road
II	120	Prob	Pontiac	Cata-lina	65	6	74,486	9,996	R.F.20/28 R.R.16/28 caused oversteer	No	No	Yes	One car ran off left curve to right side	Repeated over-corrections after sudden attempt to move to right of lane in curve	Wet road and bald tires were also present
II	129	Prob	Ford	Falcon	60	11	122,964	unknown	L.R.12/24 R.R.15/24 caused oversteer	No	No	Yes	One car ran off left curve to left after leaving pavement to right	Over-corrected after slipping off pavement on right	
II	146	Prob SI	VW	Beetle	63	8	43,646	1,632	L.F.10/16psi L.R.33/24psi R.R.18/24psi R.F.11/16psi Caused braking deficiency on wet road	No	No	Yes	Car struck parked car on right side of road	Locked brakes	Wet road, rear brake imbalance and low tread depth
II	155	Poss	Ford	3/4 ton P.U.	51	20	218,673	5,543	L.F.25/35psi L.R.34/40psi R.R.44/40psi R.F.37/35psi Prominent drift to left	No	No	Yes	Truck crossed centerline and struck car head on	Steered right and braked but too late	Driver was looking over shoulder at cargo in bed of truck when truck crossed centerline, 38° steering free-play
II	166	Prob	Ford	Galaxie	64	7	101,679	4,947	L.F.15/24 R.F.19/24 R.R.18/28 caused oversteer	No	No	Yes	One car ran off left curve to left	Slammed on brakes, slid off to right, then over-corrected to left	Wet road and bald tires also present

Table D-8 continued

Phase	Case	Certainty	Make	Model	Year	Approximate age (years)	Mileage	Miles since last PMVI	Component that failed	Assessed in current PMVI	Could design change prevent	Injury	Type of collision	Evasive action attempted	Remarks
II	173	Poss	VW	Square-back	70	1	21,862	21,854	L.F.24/17 R.F.24/17 Greater sensitivity to steering inputs, possibly hindered control recovery	No	No	Yes	Car ran off road to right and rolled over	Right steered only, overcompensated counter-clockwise skid	Road was snow covered and slick
II	174	Prob	Pontiac	Lemans	72	0	9,674	9,674	L.F.17/26 L.R.19/24 Reduced steering response	No	No	No	One car ran off road, snow on shoulder, left tires on pavement, lost control after fishtailing	Maintained 20 mph and tried to steer back	Shoulder snow covered
II	201	Prob	Chevrolet	Nova	69	3	57,445	unknown	L.R. 5/26 R.R.15/26 caused oversteer	No	No	Yes	One car ran off right curve to right	Steered	
III	1	Poss	Chevrolet	BelAir			96,772	64	R.F. 6/26 caused understeer	No	No	No	Right angle at intersection	Steered left to avoid collision	
III	30	Poss	Dodge	Colt	72	1	6,774	6,544	L.R.23/30 R.R.24/30 Caused oversteer	No	No	No	Car ran off road to right and rolled over	Steered to right excessively causing loss of control	Vehicle and four, 30 lb. concrete blocks in trunk adding to the oversteer effect of the underinflated tires
III	60	Poss	Fiat	124	73	0	20 (disconnected)		R.R.21/32 caused oversteer	No	No	Yes Fatal	One car ran off straight road after sudden attempt to regain right lane after attempted pass. Also braked	Braked and steered hard	

Table D-8 continued

Phase	Case	Certainty	Make	Model	Year	Approximate age (years)	Mileage	Miles since last PMVI	Component that failed	Assessed in current PMVI	Could design change prevent	Injury	Type of collision	Evasive action attempted	Remarks
III	62	Poss	Pontiac	Catalina	66	7	101,302	13,380	L.R.18/24 R.R.19/24 L.F.36/24 R.F.14/24	No	No	Yes	Acute oblique overcompensated in road recovery	Steered left to regain road	
IV	127	Poss	Dodge	Challenger	70	4		2,950	L.F.11/26 caused understeer	No	No	Yes	One car ran off road just past left curve to right side	Braked hard	Steering and braking problems also present
IV	152	Poss	Buick	Century	73	1		11,436	L.R.18/26 R.R.18/26 caused oversteer	No	No	Yes	Head-on on right curve, clock-wise rotation started due to oversteer. Driver steered left and braked hard causing car to travel straight into oncoming car	Braked hard and steered slightly left	Should have refrained from locked wheel braking. Wet pavement.
V	185	Poss	Chevrolet	Nova	72	2	50,620	7,874	L.R.15/24 R.R.15/24 caused oversteer	No	No	Yes	One car ran off straight road		
V	206	Poss	Plymouth	Fury	64	10	100,177	6,445	L.R.underinflated caused oversteer	No	No	Yes	One car ran off road after oversteering at intersection	Oversteered and overaccelerated	

Table D-8 continued

Phase	Case	Certainty	Make	Model	Year	Approximate age (years)	Mileage	Miles since last PMVI	Component that failed	Assessed in current PMVI	Could design change prevent	Injury	Type of collision	Evasive action attempted	Remarks
V	217	Cert SI	Ford	Fair-lane	69	5	63,196	7,441	L.F.65/25 R.R.65/25 reduced braking traction	No	No	No	Head-on	Braked hard	Should have refrained from locked wheel braking and steered
V	268	Poss	VW	Sedan	63	12	73,218	4,411	R.F.44/16 adversely affected steering dynamics	No	No	No	Lost control on curve and rolled over	Steered only	

person. The high injury rating, relative to other accidents involving vehicle factors, probably reflects control problems being related to high demands on traction and dynamic performance or, in other words, higher initial speeds. Admittedly, some of these accidents would not have happened if the driver had not initiated a severe steering or braking input when it was unnecessary.

An interesting factor which emerged is the above average mileage of the vehicles with inflation pressure problems; of the fifteen vehicles with functioning odometers, the average mileage was 68,972 miles. One of the vehicles with unknown mileage was a new car, a demonstrator, with the odometer disconnected at 20 miles. The range of mileages on these vehicles, excluding the new car above, was from 674 to 218,673 miles. Thus inflation pressure problems, although not directly influenced by wear or mileage, appear more frequently in high mileage vehicles.

Table D-8 summarizes details of the vehicles with inflation problems. Combatting this problem appears to be a task of educating drivers to the need for continuing attention to proper tire pressures. The development of a tire pressure warning device, which would warn the driver of low or high pressure also merits consideration.

The next most serious tire problem was inadequate tread depth; eleven cases were identified at the certain or probable, causal or severity-increasing level, and an additional seven cases were listed at the possible level (i.e., 18 certain, probable, or possible tread depth cases) (Table D-9). Inadequate tread depth is primarily a problem in causing a decrease in traction on wet roads. Only one of these accidents occurred on dry pavement (involving control loss with right side wheels on a paved shoulder, in the presence of various other tire problems). Eleven of these 19 accidents (58%) involved injury.

In thirteen of these cases, the driver's primary reaction was to merely brake heavily. In case 211 of Phase V, the driver merely steered in an attempt to avoid striking a tree after intentionally driving off the road, and received injuries as a result of the collision. This collision would not have been prevented had the driver braked instead, but he might have prevented injury to himself if he also braked, to reduce his speed at impact. In one other case, number 273 of Phase V, the driver braked hard at first but then released the brakes and attempted to steer. This accident also produced injury. In this case, the accident could have been avoided by releasing the brakes slightly earlier and steering, or by holding the brakes firmly locked until the car skidded harmlessly to a halt (nothing was coming and the vehicle was sliding straight down the road). This is not to say that steering and avoiding locked wheel braking will always result in avoidance of an injury producing accident. The point is in most of these accidents (13 out of 18), the drivers did not even attempt to steer, although it appears that skid recovery would often have been possible.

Table D-9 lists facts about the cases involving inadequate tread depth. Tread depth is an item required to be assessed under Indiana PMVI. The mileage elapsed since inspection ranged from a low of 779 miles to a high of 13,380 miles, with an average of 5,707 miles. Some of the vehicles with low elapsed mileage were clearly improperly inspected, if they were actually inspected at all.

Table D-10 shows additional, "miscellaneous" tire and wheel problems other than tread depth and inflation. Since there were only two cases identified at the certain or probable level in Table D-10 and three additional cases at the possible level, they will be discussed in this section together. Two cases involved decreased rear end traction on wet roads due to extremely wide tires on the rear of small, lightweight cars. Case 11 of Phase III involved a 1969 Chevrolet Nova with F60-14 tires on its rear wheels. This car ran off the road after hitting a puddle of water while drag racing. Case 73 of Phase IV involved a 1965 Ford Mustang with H60-14 tires on its rear. This car rotated more than 180° on wet pavement and traveled backward into a telephone pole. Both situations could possibly be prevented by inspection regulations prohibiting excessively wide tires for the size of the vehicle. Wide tires on small light cars can increase dry road traction substantially, but generally will decrease wet road traction from what is usually achieved with recommended tires. Adding to the danger here is that the difference from dry conditions to wet conditions is large and possibly surprising to the drivers involved.

Two cases in this section of possible, miscellaneous tire and wheel problems involved studded snow tires on dry pavement. One car, a 1970 Ford Maverick (case 133 of Phase IV) experienced rear wheel lock and subsequent severe rotation on dry pavement when another vehicle caused the subject vehicle to brake suddenly. It was believed that the apparent front to rear brake imbalance was caused by the difference in tire traction between the standard-tread front tires and the rear studded snow tires. The other case, number 13 of Phase III, involved a 1972 Chevrolet Nova that experienced alleged cornering problems after new studded snow tires were installed. Friends of the young male driver, who was fatally injured, related that he frequently drove the curve where the crash took place at maximum cornering speed. On this occasion, with newly installed studded snow tires on the rear,

Tires and Wheels, Tread Depth

Table D-9

Phase	Case	Certainty	Make	Model	Year	Approxi-mate age (years)	Mileage	Miles since last PMVI	Component that failed	Assessed in current PMVI	Could design change prevent	Injury	Type of collision	Evasive action attempted	Remarks
II	120	Prob	Pontiac	Catalina	65	6	74,486	8,996	R.F. Tire 0-2-0 R.R. Tire 0-1-3	Yes	No	Yes	1 car ran off left curve to right	Attempted to steer	Wet Road
II	131	Prob	VW	Sedan	63	8	71,371	unknown	L.F.2-2-0 R.F.2-3-0 caused loss of traction. Wet road.	Yes	No	Yes	One car ran off right curve to left.	Braked hard after skid started	Wet road
II	14[illegible]	Cert SI	VW	Sedan	63	8	43,646	1,632	R.F.0-4-2 reduced traction. Wet road.	Yes	No	Yes	Head on. Parked car on right side after steering right to avoid VW.	Braked hard	Wet road. Should have refrained from locked wheel braking and steered.
II	166	Prob	Ford	Galaxie	64	7	101,679	4,947	L.R.0-0-1 R.F.0-0-1 L.F.0-1-0 reduced traction. Wet road.	Yes	No	Yes	Slid off road on curve when braked hard	Braked hard	Wet road
II	185	Poss	Dodge	Super Bee	70	2	40,321	3,014	L.R.3-2-5 R.R.2-4-4	Yes	No	No	2 cars head on crest of hill	Steered and braked	Snow Covered Road
II	222	Cert SI	Ford	Mus-tang	67	5	56,779	11,307	L.F.2-4-7	Yes	No	Yes	Car struck other vehi-cle in rear	Braked hard	Wet road
III	62	Poss	Pontiac	Cata-lina	66	7	101,302	13,380	L.F.0-0-2 R.F.0-0-6 L.R.1-3-2	Yes	No	Yes	Car rotated during hard braking	Steered and braked hard	Various other tire problems Skidded on shoulders
IV	79	Prob	Inter-national Harves-ter	1200 Truck	64	9	105,559	779	L.F.4-0-4 R.R.0-0-0 L.R.0-0-0 reduced traction. Wet road.	Yes	No	No	Opposing oblique with parked car after skid and 180° spin	Braked hard	Wet road

Table D-9 continued

Phase	Case	Certainty	Make	Model	Year	Approximate age (years)	Mileage	Miles since last PMVI	Component that failed	Assessed in current PMVI	Could design change prevent	Injury	Type of collision	Evasive action attempted	Remarks
IV	91	Prob	Ply-mouth	Belve-dere	64	9	94,042	6,330	L.F.0-1-4 L.R.0-0-1 R.R.0-0-1 reduced traction. Wet road.	Yes	No	No	Opposing oblique	Braked hard	Wet road
IV	118	Poss SI	Dodge	Coronet 440	65	8	58,037	12,397	L.F.0-0-4 R.F.0-1-1	Yes	No	No	Opposing oblique	Braked hard	Wet and snowy road
V	204	Prob	Pon-tiac	Cata-lina	62	12	77,204	2,603	L.F.0-0-0 L.R.0-0-0 R.R.1-1-0 R.F.0-0-0	Yes	No	Yes	Ran off road at tee inter-section	Braked hard	Wet road
V	211	Poss	Chrys-ler	New-port	64	10	116,557	3,770	L.F.2-3-0 R.F.0-0-0	Yes	No	Yes	Ran off road inten-tionally, failed to recover on wet grass and hit pole.	Steered only	Wet grass. Driver was chasing squirrel.
V	216	Poss	VW	Karmin Ghia	69	5	57,736	1,058	R.R.0-0-4 Uneven traction	Yes	No	No	Tertiary impact caused by uneven braking post-impact	Braked hard	Wet road

Table D-9 continued

Phase	Case	Certainty	Make	Model	Year	Approximate age (years)	Mileage	Miles since last PMVI	Component that failed	Assessed in current PMVI	Could design change prevent	Injury	Type of collision	Evasive action attempted	Remarks
V	221	Prob	AMC	American	67	7	66,965	10,872	L.R.0-0-0 R.R.0-0-0 R.F.0-0-0	Yes	No	Yes	Head-on on slight curve	Braked hard	Snow and ice
V	223	Prob	Ford	Mustang	65	9	109,477	7,318	L.F.0-2-3 L.R.3-0-4 R.R.2-0-1	Yes	No	No	Head-on parked car	Braked hard	Snow and slush
V	225	Poss	Chevrolet	Chevelle	72	3	27,382	3,010	R.R.0-2-2	Yes	No	Yes	Ran off road after rotation during braking	Braked hard	Wet road
V	233	Poss + SI Prob	Buick	Electra 225	67	8	101,335	2,605	L.R.0-1-0 R.R.1-0-0	Yes	No	No	Right angle	Braked hard	Wet and sandy road
V	273	Poss	Chevrolet	Vega Estate Wagon	74	1	16,845	2,994	L.F.0-4-1	Yes	No	Yes	Ran off road on very sharp left turn on right side	Braked, then released and steered but too late	Wet road

Tires and Wheels, Miscellaneous

Table D-10

Phase	Case	Certainty	Make	Model	Year	Approximate age (years)	Mileage	Miles since last PMVI	Component that failed	Reason for failure	Assessed in curren PMVI	Feasible to assess in PMVI	Could design change prevent	Injury	Type of collision	Evasive action attempted	Remarks
III	11	Poss	Chev-rolet	Nova	69	3	56,591	16,842	F60-14 tires on rear too wide caused hydro-plane	Owner modified	No	Yes	—	Yes	Ran off straight road after hitting puddle	None	Wet road
III	13	Prob	Chev-rolet	Nova	72	0	3,933	3,933	Studded snows new, very deep tread changed dynamics and caused oversteer	Driver did not know studs reduce dry traction	—	—	—	Yes Fatal	Ran off road on left curve to left	Unknown	Excess speed on curve also cited
IV	73	Poss	Ford	Mus-tang	65	8	41,128	unknown	H60-14 tires on rear too wide caused hydro-plane	Owner modified	No	Yes	—	No	Ran off straight road after curve and rotated 180°	Steered	Wet road
IV	82	Cert	Chev-rolet	Malibu	62	11	75,330	unknown	Wheel loss, lugs sheered	Nonstock wheel missing two lugs due to improper mainte-nance	Yes	Yes	—	Yes	Lost wheel, spun on road	None	
IV	133	Poss	Ford	Mave-rick	70	4	30,366	7,538	Studded snow tires changed dry traction	Driver did not know studs reduced dry traction	—	—	—	Yes	Lost control and spun during hard braking, hit fixed object	Braked hard	

the back end broke traction in the curve, initiating a clockwise rotation.

The remaining case involved a wheel loss on a 1962 Chevrolet Malibu. This was case 82 of Phase IV and resulted from the combined ignorance and/or carelessness of the driver and his service mechanic. The wheels were non-stock cast alloy wheels. The wheel which failed was mounted with only four lug nuts instead of five, but the driver did not complain nor request that they be properly mounted. Of these four nuts, three were ill-fitting but non-stock items, while the fourth was a stock nut which engaged only a few of the threads on the stud. The mechanic had also overtightened one of the lug nuts, cracking the stud. Thus, only three adjacent lugs were holding the five-stud right rear wheel. The remaining lugs sheared allowing the wheel to come off, causing slight damage to the vehicle and slight injury to the right front passenger. See Table D-10 for additional details.

APPENDIX E: FOCUSED EXAMINATION OF VIEW OBSTRUCTIONS

Appendix E: Focused Examination of View Obstructions

In Phases II-V, 67 of the 420 accidents (16%) were determined to have been caused or increased in severity as the result of a view obstruction associated with the accident at the certain, probable, or possible level of certainty. In all but one of these accidents, the view obstructions were considered to be causes as opposed to severity-increasing factors.

These view obstruction-associated accidents were divided into two groups. The first group was composed of accidents which occurred at intersecting areas, and fifty of the 67 view obstruction-associated accidents (75% of these accidents or 12% of all accidents investigated) were in this category. The remaining group of 17 view obstruction-associated accidents (25%, or 4% of all accidents) occurred at non-intersecting areas (Figure E-1).

View Obstructions in Intersecting Areas (Group One)

There were always two vehicles which came in conflict with each other in this group. In all cases, the most-at-fault driver was responsible for completing a maneuver which called for surveillance of the intersecting roadway, a decision regarding the propriety of the crossing or turning maneuver at the time of its execution, and the actual performance of the maneuver. Obviously, the drivers in these cases did not satisfactorily complete these steps since these cases represent accidents, or examples of failures.

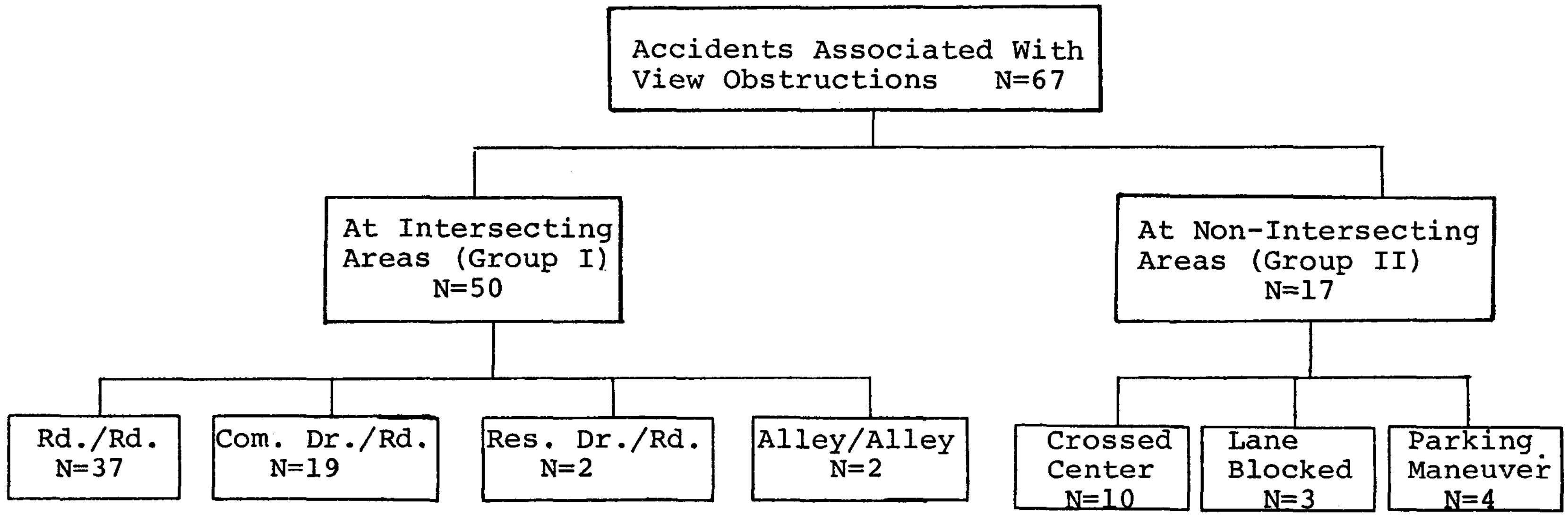
Four distinct types of intersecting areas were identified: (1) the intersection of two or more streets, roadways, highways, etc. (Road/Road); (2) the intersection of a commercial driveway with a street, roadway, highway, etc. (Com. Dr./Road); (3) the intersection of a residential driveway with a street, roadway, highway, etc. (Res. Dr./Road); and, (4) the intersection of one alley with another (Alley/Alley).

The Road/Road type proved the largest; it comprised 37 of the 50 intersection area accidents which were associated with a view obstruction (74%, or 9% of all accidents). Nine of the accidents were Com. Dr./Road situations and there were 2 each for the Res. Dr./Road and Alley/Alley types, respectively.

Results

There were either 3 or 4 legs at the various intersections included here. A leg was considered as any road or drive capable of allowing vehicular traffic to cross the

Distribution of Accidents Involving Causally-Implicated View Obstructions* Figure E-1



* Implicated in the in-depth data at the certain, probably, or possible, causal or severity-increasing level, in Phases II-V.

intersection area. Thus, each leg should have been examined by each of the (most-at-fault) drivers as they negotiated the intersection. The actual presence or absence of another vehicle on the legs didn't influence the tabulation since a leg which could have contained another vehicle, but did not, would still require a visual surveillance, to determine if it was safe to negotiate the intersection. The Road/Road type was predominately 4 legs whereas the Com. Dr./Road type was nearly evenly divided between 3 and 4 legs, having significantly more T configurations (Table E-1).

Traffic controls did not exist at any of the intersection types other than the Road/Road type, where stop signs on one or two legs were the method of control for most (76%, Table E-2). Surprisingly, 4-way stop signs were not present at any of these (Road/Road) locations.

Directional opportunity was determined by assessing whether or not it was possible for the most-at-fault driver to both physically and legally continue straight or turn left or right in the process of negotiating the intersection. This variable did not document what the drivers actually attempted to do, but only what their (legal) directional opportunities were. For the Road/Road class, the most frequent opportunity was to continue straight, but the opportunity to turn either left or right was available nearly as often (Table E-3). The Com. Dr./Road intersection type differed in that there was more opportunity to turn left or right rather than to continue straight.

When these same accidents were assessed by the directional intent of the most-at-fault driver, it was found that they were in all cases intent on either continuing straight or turning to the left, with the former predominating, but in not one instance was there an intention of turning to the right in these view-obstruction caused, Road/Road cases. Those most-at-fault drivers who were confronted with the Com. Dr./Road type of intersection were all intent on turning to the left with one exception, wherein the driver was in the process of a right turn and did not steer enough, crossing into the opposing lane where impact occurred (Table E-4).

As these drivers negotiated these intersecting areas, it was generally necessary for them to survey from 1 to 3 legs which led to the intersection. However, excluding the leg upon which the most-at-fault drivers were located, it was often possible for the surveillance to include less than the remaining number of legs, since traffic controls (e.g., one-way signs) prohibited conflicting or opposing traffic from approaching on specified legs. Although differences in number of legs to be surveyed were not significantly given the

Intersection Legs by Intersection Types   Table E-1

	INTERSECTION TYPES							
	Road/Road		Com.Dr/Road		Res.Dr/Road		Alley/Alley	
INTERSECTION LEGS	n	%	n	%	n	%	n	%
Three	4	11	4	44				
Four	33	89	5	56	2	100	2	100
TOTAL	37	100	9	100	2	100	2	100

Fisher exact probability = .036 (Road/Road V. Com.Dr/Road)

Traffic Controls by Intersection Types

Table E-2

	INTERSECTION TYPES							
	Road/Road		Com.Dr/Road		Res.Dr/Road		Alley/Alley	
TRAFFIC CONTROL	n	%	n	%	n	%	n	%
None			9	100	2	100	2	100
Signalized-4 Legs	3	8						
Stop-1 Leg	13	35						
Stop-2 Legs	15	41						
Stop-3 Legs	2	5						
Yield-2 Legs	3	8						
Do Not Enter	1	3						
TOTAL	37	100	9	100	2	100	2	100

Directional Opportunity by Intersection Types*

Table E-3

Directional Opportunity	Road/Road n	Road/Road %	Com.Dr./Road n	Com.Dr./Road %	Res.Dr./Road n	Res.Dr./Road %	Alley/Alley n	Alley/Alley %
Straight	35	37	3	14	2	50	2	33.3
Left	29	31	9	43	2	50	2	33.3
Right	30	32	9	43			2	33.3
Total	94	100	21	100	4	100	6	100

INTERSECTION TYPES

*for most-at-fault driver

Directional Intent by Intersection Types*

Table E-4

Directional Intent	INTERSECTION TYPES Road/Road n	%	Com.Dr/Road n	%	Res.Dr/Road n	%	Alley/Alley n	%
Straight	27	73					2	100
Left	10	27	8	89	2	100		
Right			1	11				
Total	37	100	9	100	2	100	2	100

*for most-at-fault driver

sample size, drivers confronted with the Road/Road intersection area most frequently had to make surveillance of only 2 legs (with a range of 1 to 3); however, it was always necessary to survey no less than 2 legs when negotiating the Com. Dr./Road type of intersection, or the remaining two other types (Table E-5).

If a driver was to make an adequate surveillance, a proper decision, and perform the necessary maneuver to safely negotiate the intersection area, it was first necessary that he/she approach the area in a manner which allowed him/her sufficient time and opportunity to do so. When the driver stopped or slowed sufficiently at the point where it was possible to perceive all the legs which required surveillance so that he/she could see, decide, and act in a safe manner, it was determined that the time allowed to discharge these responsibilities was sufficient. This did not mean an appropriate visual scan occurred; rather, it meant that there still was the opportunity to safely negotiate the intersection at that point. On the other hand, if there was insufficient time for the driver to see, decide, and act safely when he/she reached the point where it was possible to perceive all the legs which required surveillance, the time allowed for the visual scan by the driver's approach to the intersection was considered insufficient, and the outcome for the driver while in the intersection area was, at this point, a matter of chance; i.e., it was beyond his/her control for all practical purposes as to whether or not an accident resulted, and the failure was in essence one of approaching too rapidly. At the point where negotiation was left to chance, the occurrence and type of accident was determined by how the other involved driver coped with the view obstruction which now was having a more direct effect on that driver. These tabulations indicate that, about as often as not, most-at-fault drivers at Road/Road intersections approached at a rate which provided "insufficient" rather than "sufficient" time and opportunity to see, decide, and safely act. The Com. Dr./Road type differed significantly in that the most-at-fault drivers in those cases predominately had "sufficient time" and opportunity to safely negotiate the area, based upon this definition (Table E-6). The point is that--at least for Road/Road situations--the error was as much in the speed of approach as in adequate head or eye use, or manner of "easing-out" and accelerating while looking.

The view obstructions encountered by drivers were also divided into three categories according to their permanence: (1) Transitory -- the view obstruction was in motion or could be expected to be in motion after a brief period of time; (2) Transitory fixed - the obstruction was motionless

Table E-6

Opportunity for Surveillance, Decision, and Appropriate Action Based Upon Approach to Area by Intersection Types*

	INTERSECTION TYPES							
	Road/Road		Com.Dr/Road		Res.Dr/Road		Alley/Alley	
Opportunity For Surveillance, Decision, and Appropriate Action Based upon Approach To Area	n	%	n	%	n	%	n	%
"Insufficient"	17	46	1	11	1	50	2	100
"Sufficient"	20	54	8	89	1	50		
Total	37	100	9	100	2	100	2	100

*for most-at-fault driver

Fisher exact probability = .057 (Road/Road v. Com.Dr/Road)

Table E-5

Number of Legs Requiring Surveillance by Intersection Types*

Legs Requiring Surveillance	Road/Road n	Road/Road %	Com.Dr/Road n	Com.Dr/Road %	Res.Dr/Road n	Res.Dr/Road %	Alley/Alley n	Alley/Alley %
One	8	22						
Two	16	43	4	44	2	100	2	100
Three	13	35	5	56				
Total	37	100	9	100	2	100	2	100

*for most-at-fault driver

and could not be expected to change position during the time the intersection was being negotiated, and; (3) Permanent - obstructions were motionless and could reasonably be expected to remain in the same location upon repeated attempts to negotiate the particular intersection area. Wholly transitory obstructions were in the traffic stream, transitory fixed were out of the traffic stream but on the roadway, and permanent obstructions off the roadway, with the exception of one bridge pier located between opposing lanes. More than one category of obstruction could be a causal or severity-increasing factor in any one accident, so that there were more obstructions than accidents.

For the Road/Road type most causal view obstructions were permanent; whereas, the transitory category is tabulated more frequently for the Com. Dr./Road type as shown in Table E-7.

In Table E-8, the specific types of obstructions countered are identified. Trees and buildings were the most frequent obstructions in the Road/Road class, together having a causal or severity-increasing role in 23 of these 37 accidents (62%). Stopped (but non-parked, transitory) non-contact vehicles plagued drivers in 6 of the Com. Dr./Road cases (66%)--proving the most frequent obstruction for this type. It was mentioned earlier that signs and signals were found to be present only within the Road/Road group of accidents. Therefore, the assessment as to whether the obstruction blocked the driver's: (1) view of traffic, (2) signs/signals, or (3) both, was only necessary for this class. In 1 of the 37 accidents (3%), the obstruction was of signs/signals alone. In another case (3%), both traffic and signs/signals were blocked from view. In the remaining 35 Road/Road cases (95%), the causal obstructions blocked the driver's view of other traffic units (but not signs/signals).*

Four variables were assessed individually and then combined into one to assess the interaction of the drivers with qualitative descriptors of the obstructions. Degree and duration of obstruction and surmountability had two possible outcomes and effort had three; consequently, there were 24 possible permutations for the interaction variable although only 14 were identified as actually occurring in the cases.

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*Such obstruction of signs/signals may have been present, but was not related to the causation of the accident.

Table E-7

Obstruction Category by Intersection Types

Obstruction Category	INTERSECTION TYPES N=37 Road/Road		N=9 Com.Dr/Road		N=2 Res.Dr/Road		N=2 Alley/Alley	
	n	%	n	%	n	%	n	%
Transitory	10	27	6	67				
Transitory Fixed	12	32	2	22			1	50
Permanent	20	54	1	11	2	100	2	100

Table E-8

Specific Obstruction by Intersection Types

	Specific Obstruction	N=37 Road/Road n	%	N=9 Com.Dr/Road n	%	N=2 Res.Dr/Road n	%	N=2 Alley/Alley n	%
Transitory	Non-Contact Units-Stopped	1	3	4	44				
	Non-Contact Unit-Stopped	3	8						
	Non-Contact Unit-Moving	3	8	1	11				
	Non-Contact Truck-Stopped	1	3	2	22				
	Non-Contact Truck-Moving	2	5						
Transitory Fixed	Parked Unit-Legal	2	5	1	11				
	Parked Unit-Illegal	2	5						
	Parked Units-Legal	4	11						
	Parked Unit-Snow Covered & Illegal	1	3						
	Parked Truck-Legal	1	3	1	11				
	Parked Truck-Illegal	3	8						
	Construction Materials	1	3						
	Trash Dumpster							1	50
Permanent	Trees	13	35					1	50
	Building	10	27						
	Bushes	6	16					1	50
	Embankment/Wall	3	8						
	Hillcrest	1	3			2	100		
	Mailbox	1	3						
	Sign	1	3						
	Bridge Pier	1	3						
	Fence	2	5					1	50
	Solid Drive Markers			1	11				

First, the degree to which the obstruction blocked the vision of the driver was assessed as being either complete or partial. When the entire area within the obstruction allowed no visibility of events on the side opposite the viewer, the obstruction was considered to be complete. If visibility was obstructed but not completely so, the degree of obstruction was considered partial. Identifying the obstruction would not by itself be sufficient to categorize the obstruction as complete or partial. For instance, when a group of trees was cited as an obstruction, the degree to which they obstructed vision might be complete in one case and partial in another, since the degree to which a driver's vision was obstructed by trees varied with the type, dimension, seasonal state, age, etc. at the time of the collision. Such is the case with many other entities which were identified as obstructions. Consequently, after the obstruction was identified, it was necessary to assess whether the driver's vision through the range of the obstruction was completely or only partially obstructed independently of what the obstruction happened to be. The in-depth case report files included scale diagrams and color slides depicting driver's eye level views in each relevant direction, which were used to make these assessments.

Second, the duration of an obstruction was assessed by assessing the clear zones of vision available to him/her on an orthogonal leg of traffic. If a driver was able to glimpse cross-flowing traffic but once (e.g., as it emerged from behind a long row of buildings), the obstruction was considered to be continuous. If, on the other hand, a cross-flowing traffic unit could be viewed by the most-at-fault driver more than once (independent of the actual length of the view), the duration of the obstruction was assessed as being momentary. Thus, a large building situated on the corner of a block would most likely be assessed as being of continuous duration since a driver who would be scanning for cross-flowing traffic would have but one opportunity (however long) to perceive the potential traffic unit; i.e., it appears only when the building is no longer situated between the driver and the cross-flowing traffic unit.

Third, it was necessary to remain focused solely on the obstruction for another assessment which evaluated the surmountability of the obstruction, independent of the driver's effort. This was so because one could not assess the general surmountability of the obstruction by combining the degree of the obstruction with its duration. While an obstruction assessed to be complete and continuous might seem intuitively to be the most difficult obstruction to overcome, this was not always the case. The difficulty in surmounting an obstruction could be greater for an obstruction which was partial and momentary rather than complete and continuous; hence, it was necessary to assess the surmountability of the obstruction independent of the actual driver's effort. Scaled diagrams and slides depicting simulated driver's eye level views of the obstructed quadrant for the most-at-fault driver at the time of the accident were used to make the assessments. The surmountability of the obstruction was assessed as being either simple or complex (i.e., "easy" or "difficult"). Note that the hypothetical driver used to assess the surmountability of the obstruction was assumed to have complied with the signs/signals controlling the intersection, if they were available, or to have exhibited safe driving practices in intersection areas where no controls were present.

Finally, the actual effort of the driver to overcome the obstruction was assessed as being reasonable, unreasonable, or non-existent. A reasonable effort meant that the most-at-fault driver was aware of the view obstruction and attempted to overcome the obstruction by scanning for cross-flowing traffic more than would be necessary at an unobstructed intersection. However, due to the surmountability of the obstruction being complex, he/she may have entered the intersecting area with limited information despite a concerted effort. Or, such a driver may have encountered an obstruction which could be simply overcome, but who despite making a reasonable effort was unable to obtain the available and necessary information prior to beginning negotiation of the intersection due to a personal vision problem. An unreasonable effort was one where the driver was aware of the obstruction but scanned for cross-flowing traffic with an effort which (while possibly reasonable for an unobstructed area), was unreasonable given that such an obstruction existed. In most of these cases, minimal additional effort would have greatly increased the likelihood of the driver safely negotiating the area. Nonexistent efforts were those where the driver made no attempt to scan for cross-flowing traffic and entered the intersection area with no information regarding it.

While there were 24 permutations for the attributes of the driver and obstruction interaction (i.e., variable interaction of the obstruction's degree, duration, surmountability independent of the driver's effort, and the actual effort of the driver), only 14 of these permutations were found to exist within these cases. Overall, the driver's effort to surmount these obstructions was considered either inadequate or non-existent in 87% of the large Road/Road class of cases (46% inadequate and 41% non-existent) (Table E-9).

Table E-9

Driver-Obstruction Interaction by Intersection Types*

Driver-Obstruction Interaction+	Road/Road n	Road/Road %	Com.Dr/Road n	Com.Dr/Road %	Res.Dr/Road n	Res.Dr/Road %	Alley/Alley n	Alley/Alley %
C, C, S, R	1	3						
C, C, S, U	5	14	1	11	2	100		
C, C, S, N	11	30					1	50
C, C, C, R	3	8						
C, C, C, U	2	5	1	11				
C, C, C, N			1	11				
C, M, S, R								
C, M, S, U	3	8	1	11				
C, M, S, N	2	5						
C, M, C, R	1	3						
C, M, C, U								
C, M, C, N								
P, C, S, R								
P, C, S, U	2	5	2	22				
P, C, S, N	1	3	2	22			1	50
P, M, S, R								
P, M, S, U	4	11	1	11				
P, M, S, N	1	3						
P, C, C, R								
P, C, C, U	1	3						
P, C, C, N								
P, M, C, R								
P, M, C, U								
P, M, C, N								
Total	37	101	9	100	2	100	2	100

*for most-at-fault driver

+1st Column - Degree

C = Complete
P = Partial

2nd Column - Duration

C = Continuous
M = Momentary

3rd Column - Surmountability

S = Simple
C = Complex

4th Column - Effort

R = Reasonable
U = Unreasonable
N = Non-existent

In Table E-9 it may be seen that the cell having the most entries (11) denotes accidents at regular Road/Road intersections, for which the causal view obstruction was complete (i.e., was so tall or dense as to completely block view); continuous (meaning that the relevant stream of traffic was only visible once, such as when it emerged from behind a long row of buildings); and simple to overcome (i.e., the driver should have been able to easily and safely surmount the obstruction); although no identifiable effort was made. The next most populous cell (n=5) is the same, except for these cases the drivers did make some visual surveillance effort, it was not adequate or reasonable given the presence of the view obstruction.

Overall, these results are somewhat encouraging for at least trying to improve driver training and testing in the areas of surmounting view obstructions. Most of these cases did not involve complex situations where, despite great efforts, unsuspecting drivers fell victim to hazards they could not possibly overcome. Instead, in what should have been fairly simple situations to deal with, these drivers made either a minimal effort, or no effort at all.

In Table E-10, the direction from which the other-involved vehicle approached the impact area relative to vehicle attitude for the most-at-fault driver was tabulated for the various intersection types. In the Road/Road type, it was almost equally likely the vehicle with the right-of-way approached from a clock position of 3 as 9 (i.e., from the right as from the left). However, the most-at-fault driver whose view was blocked in the Com. Dr./Road type was almost always struck from his left; i.e., by a vehicle approaching from a clock position of 9. This difference, while not supported by statistical testing due to the small sample size, could if later proven reliable, be attributable to a number of reasons. First, drivers at Com. Dr./Road intersections more frequently approached in a manner which allowed them sufficient opportunity to scan cross-flowing traffic before departing the commercial drive. This is in contrast to drivers at Road/Road type intersections who are almost evenly divided in providing themselves sufficient or insufficient time to scan cross-flowing traffic (Table E-6). As a result, there may be a more random distribution of side impact directions in the latter cases, because these same drivers may tend to have little if any information regarding the presence of vehicles on the cross-flowing legs of the intersection. Conversely, the drivers at Com. Dr./Road intersections are more likely to allow themselves the opportunity to scan for traffic and, in turn, may acquire some information prior to maneuvering into the intersection.

Table E-10

Direction From Which Other Vehicle Approached Impact by Intersection Types

INTERSECTION TYPES

Direction from which other vehicle approached impact	Road/Road		Com.Dr/Road		Res.Dr/Road		Alley/Alley	
	n	%	n	%	n	%	n	%
12 o'clock	3	8			2	100		
3 o'clock	16	43	1	11			1	50
9 o'clock	18	49	8	89			1	50
Total	37	100	9	100	2	100	2	100

Secondly, while the drivers at Com. Dr./Road intersections tend to stop and scan before exposing themselves to a potential conflict situation, they seem to encounter a different category of view obstruction. The obstruction is usually transitory or in the stream of traffic (e.g., another vehicle in the curb lane) as opposed to a more random distribution of obstruction categories in the Road/Road situation (Table E-7). In other words, the location of the obstruction may imply that the Com. Dr./Road intersection drivers are viewing the cross traffic (because the obstruction is in the traffic stream) but are not obtaining enough information whereas the Road/Road type drivers are dismissing the same traffic earlier in the collision sequence because they can't see any. This may also explain why the latter drivers tend not to provide themselves with adequate opportunity to scan and obtain a proper lookout in the first place. Finally, another possible explanation is that Com. Dr./Road drivers appear to be turning left (Table E-4) onto the major road most of the time, and most travel over two lanes of cross traffic to complete their maneuver. This is in contrast to the Road/Road drivers who tend to continue straight across roads with fewer travel lanes. In short, exiting from an uncontrolled commercial drive may be more difficult than at an intersection because of the roadway characteristics, obstruction encountered and type of maneuver.

There were four general human factors associated with drivers whose view was causally-obstructed. As for accidents generally, human direct causes were more frequently cited than human conditions or states, and of the human direct causal factors, recognition errors were cited more frequently than decision errors for both the Road/Road and Com. Dr./Road types of intersection (Table E-11).

In the two larger intersection types, Road/Road and Com. Dr./Road, improper lookout was the most common direct human cause (Table E-12), being cited for 46% and 89% of the most-at-fault drivers, respectively, at the "possible cause" level or above.

View Obstructions in Non-intersecting Areas (Group II)

There were 17 view obstruction-associated accidents (25%, or 4% of all accidents) which occurred at non-intersection areas. These accidents were categorized into 3 types as follows: (1) Crossed Center, representing accidents where a driver crossed center and entered the opposing lane of traffic; (2) Lane Blocked, where the traffic lanes in one direction of travel were blocked and disrupted the normal flow of traffic for those same lanes; and, (3) Parking Maneuver, where a driver was attempting to depart from a parking stall.

Table E-11

General Human Factors for Most-At-Fault Driver by Intersection Types

INTERSECTION TYPES

General Human Factors (Cert,Prob, or Poss; Causal or S/I)	N=37 Road/Road n	%	N=9 Com.Dr/Road n	%	N=2 Res.Dr/Road n	%	N=2 Alley/Alley n	%
Recognition*	32	86	9	100	2	100	1	50
Decision*	15	41	6	67	1	50	2	100
Mental/ Emotional+	3	8	1	11				
Physical/ Psychological+	1	3						

*Direct cause
+Condition or State

Table E-12

Specific Human Factors for Most-At-Fault Driver by Intersection Types

	Specific Human Factor (Cert, Prob, or Poss; Causal or S/I)	INTERSECTION TYPES N=37 Road/Road n	%	N=9 Com.Dr/Road n	%	N=2 Res.Dr/Road n	%	N=2 Alley/Alley n	%
	Improper Lookout	17	46	8	89	2	100	1	50
	Fail See Stop Sign	11	30						
	Inattention	7	19						
*	Delayed Recognition	4	11						
	Preoccupation	1	3						
	Internal Distraction	1	3						
	Improper Driving Technique	7	19	4	44	1	50	2	100
	False Assumption	6	16	3	33			1	50
**	Improper Maneuver	2	5	1	11				
	Improper Evasive Action	1	3						
	Misjudgment	1	3			1	50		
	Pressure-Other Drivers	2	5						
+	In-Hurry	1	3	1	11				
++	Vision Impairment	1	3						

*Recognition Errors
**Decision Errors
+Mental/Emotion Conditions
++Physical/Psychological Conditions

The variables used to describe these different types are identified in the tables. Because of the small sample size, no statistical testing was done. The Crossed Center type was the largest; it constituted 10 of the 17 non-intersection area accidents which were associated with a view obstruction (59%, or 2% of all accidents). There were 3 Lane Blocked and 4 Parking Maneuver types, respectively.

Obviously, the insufficient sample size on this level of detail precludes statements which may be fairly supported by the data. Nevertheless, a scenario of the Crossed Center type is provided. According to the results (see Tables E-13 - E-20), this type of accident--in which one driver crosses into the opposing lane of traffic given a causally related view obstruction-seemed to occur under the following circumstances. First, the horizontal profile was curved rather than tangent and with one exception the radius of curvature was $\leq$ 260 feet. The vertical profile was less likely to be level than for accidents generally. In all cases the at-fault driver was intent on remaining in his/her own lane. View obstructions assessed as being causally related in these cases were all classified in the permanent category, since they consisted of foliage, embankments, and a hillcrest. The most-at-fault drivers usually did not make a reasonable effort to overcome the obstruction. In contrast to the most-at-fault drivers in intersecting areas, these drivers erred less due to recognition failures; instead the errors were almost evenly divided among recognition, decision, and performance factors, with the latter being cited only with the Group II accidents. When there were recognition errors, they were due to the driver being distracted or inattentive rather than the improper lookout variety which was so common in the Group I accidents.

The other two types, Lane Blocked and Parking Maneuver, while probably distinct from the Crossed Center type, occurred too infrequently to discuss.

Results of a separate examination of interactions between causally-relevant view obstructions and other factors are summarized in Table E-21. It may be seen that to a statistically significant extent, the involvement of view obstructions was associated with an increased involvement of: (1) Failed to Observe and Stop for Stop Sign--a special category outside the IRPS causal hierarchy; (2) Improper Lookout; (3) False Assumption (e.g., assumed nothing was coming, or responded to being waved on out into traffic by one motorist and being hit by another); (4) Improper Driving Technique and specifically, (5) Cresting Hills Driving in Center of Road. Table E-21 shows that when a view obstruction was cited as a certain or probable, causal

Table E-13

Horizontal Profile for Most-At-Fault Driver by Non-Intersection Type

NON-INTERSECTION TYPE

Horizontal Profile	N=10 Crossed Center n	%	N=3 Lane Blocked n	%	N=4 Parking Maneuver n	%
Tangent			2	67	3	75
Curve Right	7	70			1	25
Curve Left	3	30	1	33		

Table E-14

Verticle Profile for Most-At-Fault Driver by Non-Intersection Types

	NON-INTERSECTION TYPE					
	N=10 Crossed Center		N=3 Lane Blocked		N=4 Parking Maneuver	
Vertical Profile	n	%	n	%	n	%
Level (< 27%)	3	30			3	75
Crest	1	10				
Positive Grade	2	20			1	25
Negative Grade	4	40	3	100		

Table E-15

Directional Intent for Most-At-Fault Driver by Non-Intersection Type

Directional Intent	NON-INTERSECTION TYPE N=10 Crossed Center n	%	N=3 Lane Blocked n	%	N=4 Parking Maneuver n	%
Continue in Lane	10	100	3	100		
Backing out (Angle Parking)					2	50
Pulling out (Parallel Parking)					2	50

Table E-16

Obstruction Category by Non-Intersection Types

Category of Obstruction	NON-INTERSECTION TYPE: N=10 Crossed Center n	%	N=3 Lane Blocked n	%	N=4 Parking Maneuver n	%
Transitory						
Transitory Fixed					4	100
Permanent	10	100	3	100		

Table E-17

Specific Obstruction by Non-Intersection Types

NON-INTERSECTION TYPE

	Specific Obstruction	N=10 Crossed Center n	%	N=3 Lane Blocked n	%	N=4 Parking Maneuver n	%
Transitory Fixed	Parked Car-legal					3	75
	Double Parked Truck-illegal					1	25
Permanent	Foliage	5	50	1	33		
	Embankment	4	40				
	Hillcrest	1	10	2	67		

Table E-18

Driver-Obstruction Interaction by Non-Intersection Types*

Driver-Obstruction Interaction+	N=10 Crossed Center n	N=10 Crossed Center %	N=3 Lane Blocked n	N=3 Lane Blocked %	N=4 Parking Maneuver n	N=4 Parking Maneuver %
C, C, S, U	6	60	1	33	1	25
C, C, S, N	1	10				
P, C, S, U	1	10			3	75
P, C, S, N	1	10				
P, C, C, R			2	67		
P, C, C, N	1	10				

*for most-at-fault driver

+1st Column - Degree

C = Complete
P = Partial

2nd Column - Duration

C = Continuous
M = Momentary

3rd Column - Surmountability

S = Simple
C = Complex

4th Column - Effort

R = Reasonable
U = Unreasonable
N = Non-existent

Table E-19

General Human Factors for Most-At-Fault Driver by Non-Intersection Type

NON-INTERSECTION TYPE

General Human Factors (Cert., Prob., Poss.; or Causal or S/I)	N=10 Crossed Center n	%	N=3 Lane Blocked n	%	N=4 Parking Maneuver n	%
Recognition*	4	40			4	100
Decision*	4	40	3	100	1	25
Performance*	3	30	1	33		
Experience/Exposure+	2	20				

* Direct Cause

\+ Condition or State

Table E-20

Specific Human Factors for Most-At-Fault Driver by Non-Intersection Type

NON-INTERSECTION TYPE

	Specific Human Factors (Cert., Prob., or Poss.; Causal or S/I)	N=10 Crossed Center n	%	N=3 Lane Blocked n	%	N=4 Parking Maneuver n	%
*	Improper Lookout					4	100
*	Internal Distraction	3	30				
*	Inattention	1	30				
**	Improper Driving Technique	4	40			1	25
**	Inadequate Defensive Driving Technique			1	33		
**	Excessive Speed	3	30	2	67		
**	Improper Evasive Action	2	20				
**	Improper Maneuver	1	10				
+	Overcompensation			1	33		
+	Inadequate Directional Control	3	30				
++	Road/Area Unfamiliarity	1	10				
++	Driver Inexperience	1	10				

* Recognition errors
** Decision errors
\+ Performance errors
++ Experience/Exposure

Table E-21

Incidence of Selected Other Causal Factors* Given the Presence or Absence of Causally-Relevant View Obstructions (with presence for all factors based on citation at certain or probable, causal or severity-increasing level).

Factor	View Obstruction Cited n	View Obstruction Cited %	View Obstruction Not Cited n	View Obstruction Not Cited %	Relative Involve. Factor (RIF)	Significance (P)
A. Recognition Errors	34	40.5	219	36.4	-	NS
1. Reasons Identified	29	34.5	184	30.6	-	NS
a. Improper Lookout	24	28.6	77	12.8	2.2	.003
b. Inattention	6	7.1	60	10.0	-	NS
c. Internal Distraction	1	1.2	37	6.2	-	NS(.101)
2. Recognition-Other/Unk.	4	4.8	28	4.7	-	NS
B. Fail to Observe and Stop for Stop Sign	8	9.5	19	3.2	3.0	.012
C. Decision Errors	35	41.7	209	34.8	-	NS
1. False Assumption	10	11.9	27	4.5	2.6	.011
2. Misjudgment of Speed/Dist.	2	2.4	16	2.7	-	NS
3. Improper Maneuver	3	3.6	22	3.7	-	NS
4. Improper Evasive Action	3	3.6	55	9.2	-	NS(.131)
5. Improper Driving Technique	9	10.7	28	4.7	2.3	.041
a. Cresting Hills in Center	4	4.8	3	0.5	9.6	.022
6. Excessive Speed	6	7.1	64	10.6	-	NS
D. Performance Errors	2	2.4	45	7.5	-	NS(.133)
E. Slick Roads (Env. Factor)	2	2.4	39	6.5	-	NS
F. Vehicle Problems	1	1.2	52	8.7	.14	.029
1. Brake System Probs.	1	1.2	22	3.7	-	NS
2. Tires/Wheels	0	0	17	2.8	-	NS

*Additional factors beyond those shown were examined. All examined and found to vary significantly are shown, along with other selected factors of interest. Data are based on certain or probable, causal or severity-increasing level for both view obstructions and other factors examined. At this level, view obstructions were cited for 84 of 685 drivers/vehicles (12.3%). Note that percentages apply to driver/vehicle units rather than accidents.

or severity-increasing factor, improper lookout was cited for the same driver and at the same level 2.2 times as often as where view obstructions are not cited (28.6% of the time given a view obstruction, 12.8% of the time in their absence). View obstructions were associated with a significantly smaller incidence of causally-relevant vehicular problems; i.e., vehicle factors were significantly under-involved for accident drivers/vehicles experiencing causally-relevant view obstructions.

Summary and Conclusions

View obstructions were a causal phenomenon associated with accidents in both intersecting (Group I) and non-intersecting areas (Group II), although they were cited more frequently among accidents occurring in intersecting areas. These view obstructions were categorized as either transitory, transitory fixed, or permanent. All of the transitory obstructions were vehicles in the traffic stream which were moving and could be expected to move during the time they were to have been overcome by the most-at-fault driver. While these vehicles constituted an obstruction, they made no physical contact with any of the involved traffic units; consequently, they were designated as non-contact units. This type of view obstruction was only found in the Group I accidents, occurring 16% of the time. Transitory fixed obstructions were parked vehicles (legal or illegal) which were usually in the roadway and adjacent to the traffic stream. They were found in 30% of the Group I and 23% of the Group II accidents. The largest category of view obstruction for both groups was the permanent variety which was off of the roadway in all but one case (viz, a bridge pier). "Trees, bushes and foliage" was the most often cited factor in this category. Permanent obstructions were a causal factor in 46% of the Group I cases and 76% of the Group II cases.

The view obstructions almost invariably affected the driver's view of other traffic units rather than of signs and signals. The latter type was found in only 3% of the cases. In 43% of the cases the degree of the obstruction was considered complete in that there was no view at all through the entire area of the obstruction. The same obstructions were assessed as continuous in duration because they allowed but one glimpse of other traffic by the most-at-fault driver (independent of the actual length of the view). Furthermore, the surmountability of these obstructions while often considered simple was coupled by an effort on the part of the most-at-fault driver to do so which was either unreasonable (inadequate) or non-existent.

Sixty-five of the 67 view obstruction cases were multiple vehicle accidents; thus, because of the obstruction and the failure of the most-at-fault driver to overcome it, other drivers (who were limited by the same obstruction) could not see the former vehicle until the point where the opportunity for avoiding impact was minimal. In other words, view obstructions increase the chance of involvement in an accident for other drivers who are performing the task of driving as well as may be expected of them, but the events preceding the accident are unknown until there is little if any time to alter them.

For both groups of accidents, the human causes cited most often were recognition errors (78% of the cases), rather than decision or performance errors. Nevertheless, in nearly half of these cases (48%), the same drivers made decision errors, especially "improper driving technique" (e.g., "rolling" a stop sign, ignoring a yield sign, cresting a hill or negotiating a curve in the middle of the road). Performance errors were infrequently associated with view obstruction accidents, occurring 6% of the time and only in the Group II cases.

Typologies with each group of view obstruction-associated accidents were conceptualized; unfortunately, this level of detail made the sample too small for statistically verifying possible differences among the various types of view obstruction accidents. It is possible, however, that the type of obstruction and how a driver copes with it varies with the location (e.g., Road/Road and Permanent vs. Com. Dr./Road and Transitory). Additional data, perhaps from other MDAI cases, would be needed to validate the possible differences these typologies suggest.

All but the four parking maneuver type cases in the non-intersection view obstruction accidents were rural. Conversely, all but the two Res. Dr./Road type cases in the intersection accidents were urban.

Since many of the causally-relevant view obstructions consisted of more readily movable objects such as trees, bushes, and other foilage, efforts to clear such obstructions at least from high accident intersections may prove both feasible and effective. And, given the frequent absence of adequate efforts to overcome even easily surmountable obstructions, and the overinvolvement of "improper lookout" and other driver errors in these accidents, efforts to at least try to improve the training and testing of drivers in dealing with such view obstructions appear warranted.

APPENDIX F: MAJOR IN-DEPTH DATA COLLECTION FORMS

In-Depth Human Factors Form

In-depth Case Number______ Drivers Name__________________________ Number________

Address____ Phone________

Date of Collision___/___/___ Time___:___ AM PM

Location____

Interviewer____

Date of Interview___/___/___ Time___:___ AM PM

Location of Interview____ DPA ONLY: Date Rec'd___

Phase and Array Number	5 5 5 (01 02 03)
Number of: Traffic Units per Accident	__ __ (04 05)
On-Site, In-Depth Flag	__ (06)
On-Site Case Number	__ __ __ __ (07 08 09 10)
Traffic Unit Number	__ __ (11 12)
Card Number	0 1 (13 14)

DEMOGRAPHIC CHARACTERISTICS

1. Sex

__(1) Male
__(2) Female

__ (15)

2. Age ________ __ __ (16 17)

Date of Birth: Month ________ __ __ (18 19)

Day ________ __ __ (20 21)

Year ________ __ __ (22 23)

3. Height ______ (in inches______)
(in cm_______) __ __ (24 25)

4. Weight ______lbs __ __ __ (26 27 28)

(in kilograms__________)

5. What was the highest grade that you completed in school?

__(1) 1-7 years
__(2) 8-11 years
__(3) H.S. graduate
__(4) 1-3 years of college
__(5) College graduate
__(6) Post-grad or professional degree
__(7) Vocational, technical, or business school

__ (29)

6. Are you the main wage earner?

__(1) Yes (GO TO ITEM 9)

NO

__(2) respondent's spouse
__(3) respondent's parents
__(4) other (specify:_______________
_______________________________)

__ (30)

7. What are you doing at the present time?

__(1) Housewife
__(2) Student
__(3) Retired
__(4) Other (specify:_______________
_______________________________)

__ (31)

8. Do you have any kind of job - full-time or part-time - for which you receive pay?

__(1) full-time (Type of job:__________
_______________________________)

__(2) part-time (Type of job:__________
_______________________________)

__(3) None

__ (32)

In-Depth Human Factors Form

9. Now, regarding the main wage earner, how are you (or is he/she) employed? (Describe type of work ______________

______________________________________)

__(1) Professional, technical, and kindred
__(2) Non-farm managers, officials and proprietors
__(3) Farmers and farm managers
__(4) Clerical and kindred
__(5) Sales workers
__(6) Craftsmen, foreman and kindred
__(7) Operatives and kindred
__(8) Private household workers
__(9) Service workers
__(10) Farm labors and foreman
__(11) Laborers, except for farm and mine
__(12) Housewife
__(13) Student
__(14) Other (specify:______________

______________________________) 33 34

10. How long have you (or he/she) been with the present employer?

______years (in months______) 35

11. How many different employers have you (or he/she) worked for in the past five years?

__________ 36

12. About how much was your total family income last year? (List the combined incomes of the principal wage earners of the supporting household)

__(1) under $3,000
__(2) $3,000-5,999
__(3) $6,000-7,999
__(4) $8,000-11,999
__(5) $12,000-14,999
__(6) $15,000-19,999
__(7) $20,000-24,999
__(8) $25,000 or more 37

13. How many persons are living on this income?____________ 38

14. What is your present marital status?

__(1) single
__(2) married
__(3) divorced or separated
__(4) widowed
__(5) other (specify:____________) 39

15. How many times, if any, have you previously been married?

__(1) never been previously married
__(2) once
__(3) two or more times
__(4) no response 40

16. Do you have any dependent children?

__(1) yes
__(2) no (GO TO ITEM 17)

How many of them presently reside with you in your home?

__(1) none
__(2) one
__(3) two
__(4) three or more 41

17. In the last ten years, how many times have you moved - moved from one address to another?

__(1) never (GO TO ITEM 19)
__(2) once
__(3) 2 or 3 times
__(4) 4 or 5 times
__(5) 6 or 7 times
__(6) 8 or more times
__(7) no response 42

18. About how far did you move the last move that you made? __________miles 43

PHYSICAL CONDITION

19. Were you feeling physically normal prior to the accident?

__(1) yes
__(2) no (explain:__________________

______________________________) 44

20. How is your general health?

__(1) excellent
__(2) good
__(3) fair
__(4) poor 45

21. Have you ever had a serious illness or injury that still bothers you?

__(1) yes (explain:__________________

______________________________)

__(2) no 46

In-Depth Human Factors Form

22. Are you disabled or do you have any physical handicaps?

__(1) Yes (explain:____________________ ________________________________)

__(2) No

__ 47

23. Do you wear glasses or contact lenses?

__(1) Yes, wearing at the time of accident
__(2) Yes, not wearing at the time of accident
__(3) No

__ 48

24. Is your driver's license subject to any restrictions?

__(1) Yes, (specify:________________ ______________________________)

__(2) No

__ 49

25. Did you go to bed at your normal bedtime the evening prior to the accident?

__(1) Yes
__(2) No (explain:__________________ ______________________________)

__ 50

26. How many hours of sleep did you get?

____________hours

__ __ 51 52

27. Were you sleepy or drowsy at the time of the accident?

__(1) Yes (explain:________________ ________________________________ ________________________________)

__(2) No

__ 53

28. Were you feeling unusually tired or fatigued from your day's activities?

__(1) Yes (explain:________________ ________________________________ ________________________________)

__(2) No

__ 54

PSYCHOLOGICAL CONDITION

29. Were you under any particular emotional strain before the accident?

__(1) Yes (explain:___________________ ________________________________)

__(2) No

__ 55

30. Did you have any disagreements with a member of your family, a friend, or someone where you work before the accident?

__(1) Yes (explain:___________________ ________________________________)

__(2) No

__ 56

Which of the following words best describes how often you (had an upset stomach) in the past year: often, sometimes, rarely, never? (Code 1, 2, 3 or 4, respectively and repeat for each condition)

31. __had an upset stomach __ 57

32. __had headaches __ 58

33. __felt nervous or tense __ 59

34. __worried about things __ 60

35. __felt depressed __ 61

How often have you found the following things to be annoying or troublesome: often, sometimes, rarely, or never? (Code 1, 2, 3, or 4, respectively and repeat for each condition)

36. __Conditions where you work (or go to school, or on last job if presently unemployed) __ 62

37. __Conditions around the neighborhood __ 63

38. __Conditions around home at the present time __ 64

39. __Conditions around your home while you were growing up __ 65

In-Depth Human Factors Form

SOCIAL PARTICIPATION

40. Do you belong to any organizations like civic groups, fraternaties, church groups, unions, and so on?

__(1) Yes (GO TO SPECIAL FORM, page 4A)
__(2) No

__ 66

DRIVING EXPERIENCE

41. How long have you been driving?

______years (in months______)

__ __ __ 67 68 69

42. How many miles do you think that you have driven in the last twelve-month period?

_________miles

(_________miles/100)

__ __ __ 70 71 72

43. Which of the following types of driver training have you successfully completed?

__(1) no driver training
__(2) high school course
__(3) college course
__(4) private driver school
__(5) other (specify:______________
______________________________)

__ 73

ACCIDENT/VIOLATION HISTORY

44. How many accidents prior to this one have you ever been involved in while driving?

_____________accidents

__ __ 74 75

45. How many of these occurred in the last 5 years?

_____________accidents

__ __ 76 77

46. How many of these occurred in the last two years?

_____________accidents

__ __ 78 79

47. How many of these occurred in the last year?

_____________accidents

__ 80

STOP

GO TO 02

48. In how many of the total number of accidents that you have been involved in were you judged at fault?

______________accidents

__ __ 15 16

49. Has your car insurance ever been cancelled?

__(1) Yes (explain:________________
_____________________________)
__(2) No

__ 17

How many times have you been ticketed for any of the following types of moving traffic violations?

○ Never been ticketed (GO TO ITEM 58)

50. __speeding over the limit — __ __ 18 19

51. __reckless driving — __ __ 20 21

52. __DWI — __ __ 22 23

53. __other (specify:_______________
_______________________________) — __ __ 24 25

How many times have you been ticketed for any of the following types of moving traffic violations in the past year?

○ Haven't been ticketed in the last year

54. __speeding over the limit — __ __ 26 27

55. __reckless driving — __ __ 28 29

56. __DWI — __ __ 30 31

57. __other (specify:______________
______________________________) — __ __ 32 33

58. Has your driver's license ever been suspended or revoked?

__(1) Yes (explain:_________________
_____________________________)
__(2) No

__ 34

NAME OF ORGANIZATION	MEMBER	ATTENDANCE	FINANCIAL CONTRIBUTIONS	COMMITTEE MEMBER	OFFICES HELD
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
Total the number of checkmarks (✓) in each column					
	T_1	T_2	T_3	T_4	T_5

DIRECTIONS FOR USING THE SOCIAL PARTICIPATION SCALE

1. List the organizations with which the driver and spouse are affiliated (at the present time) as indicated by the five types of participation No. 1 to No. 5 across the top of the schedule. It is not necessary to enter the date at which the person became a member of the organization. It is important to enter L if the membership is in a purely local group, and to enter N if the membership is in a local unit or some state or national organization.

2. An organization means some active and organized grouping, usually but not necessarily in the community or neighborhood of residence, such as club, lodge, business or political or professional or religious organization, labor union, etc.; subgroups of a church or other institution are to be included separately provided they are organized as more or less independent entities. If applicable indicate with a checkmark (✓).

3. Record under attendance the mere fact of attendance or nonattendance without regard to the number of meetings attended. If applicable indicate with a checkmark (✓).

4. Record under contributions the mere fact of financial contributions or absence of contributions, and not the amount. If applicable indicate with a checkmark (✓).

5. Previous memberships, committee work, offices held, etc., should not be counted or recorded in computing the final score. Checkmark (✓) current committees or offices held.

6. Final score is computed by counting each membership as 1, each attended as 2, each contribution as 3, each committee membership as 4, and each office held as 5. If both driver and spouse are living together regularly in the home, add their total scores and divide the sum by two.

SOCIAL PARTICIPATION SCORE = $T_1 + 2T_2 + 3T_3 + 4T_4 + 5T_5$

______________________ = ___

RETURN TO PAGE 4, DRIVING EXPERIENCE

In-Depth Human Factors Form

VEHICLE FAMILIARITY

59. Is the accident vehicle your primary mode of transportation?

__(1) Yes (GO TO ITEM 60)
__No

If NO, what type of vehicle do you normally drive?

Year ______ Make ______________________

Model ______________________

__(2) Full size (Buick Electra, Chevrolet Bel Air, etc.)
__(3) Intermediate (Chevelle, Charger, etc.)
__(4) Compact (Dart, Nova, etc.)
__(5) Subcompact (Vega, VW, etc.)
__(6) Sports Car (MG, Corvette, etc.)
__(7) Light truck (Pickup, Van)
__(8) Multipurpose Utility Vehicle (e.g., Jeep, Scout, Blazer, etc.)
__(9) Other (bicycle, etc.)
__(10) Don't usually drive

__ __ 35 36

60. How long have you driven the accident vehicle?

______ years (in months ______)

__ __ __ 37 38 39

61. How many miles have you driven it in the last twelve-month period?

______________ miles

(____________ miles/100)

__ __ __ __ 40 41 42 43

VEHICLE CONDITION

62. Has your vehicle had any repairs or new parts in the last 6 months?

__(1) Yes
__(2) No (GO TO ITEM 69)

__ 44

If YES, which of the following components was (were) affected? (Check all that apply and specify work done!)

63. __brakes ______________________

______________________ __ 45

64. __tires ______________________

______________________ __ 46

65. __power train ______________________

______________________ __ 47

66. __steering ______________________

______________________ __ 48

67. __suspension ______________________

______________________ __ 49

68. __other (specify: ______________________

______________________) __ 50

69. Did the vehicle have any unrepaired damage from previous accidents?

__(1) Yes (explain: ______________________

______________________)

__(2) No

__ 51

70. How do you determine when your vehicle will be serviced?

__(1) mileage-per owner's manual
__(2) mileage-per own judgment
__(3) when a problem arises
__(4) when maintenance person suggests a need
__(5) no particular method
__(6) other (specify: ________________)

__ 52

71. How many miles do you think you have driven since any of your brake shoes or pads were last replaced?

__(1) never replaced (GO TO ITEM 76)
__(2) less than 10,000 miles
__(3) 10,000 to 25,000 miles
__(4) 25,000 miles or more
__(5) don't know

__ 53

Which shoes or pads were replaced? (Check all that apply!)

72. __left front __ 54

73. __left rear __ 55

74. __right rear __ 56

75. __right front __ 57

In-Depth Human Factors Form

How long has each of your tires been in its present position?

76. Left front

__(1) less than 10,000 miles
__(2) 10,000-25,000 miles
__(3) more than 25,000
__(4) don't know

58

77. Left rear

__(1) less than 10,000 miles
__(2) 10,000-25,000 miles
__(3) more than 25,000
__(4) don't know

59

78. Right rear

__(1) less than 10,000 miles
__(2) 10,000-25,000 miles
__(3) more than 25,000
__(4) don't know

60

79. Right front

__(1) less than 10,000 miles
__(2) 10,000-25,000 miles
__(3) more than 25,000
__(4) don't know

61

80. Do you think all of your tires have sufficient tread?

__(1) yes
__(2) no (explain:________________
________________)
__(3) don't know

62

81. When were your tire pressures last checked?

__(1) within the last week
__(2) more than a week but less than a month
__(3) more than a month
__(4) don't know

63

82. Was there any part of the vehicle that was not working properly immediately before the accident?

__(1) Yes (explain:________________
________________)
__(2) No

64

83. Was there anything in particular about the vehicle which may have contributed to the accident?

__(1) Yes (explain:________________
________________)
__(2) No

65

TRIP/ROADWAY

84. Where did your trip originate?

__(1) home
__(2) work
__(3) shopping
__(4) school
__(5) recreation
__(6) friends or relatives
__(7) restaurant
__(8) personal business
__(9) cocktail/bar/wet party
__(10) other (specify:________________
________________)

66

85. What was the intended destination of the trip?

__(1) home
__(2) work
__(3) shopping
__(4) school
__(5) recreation
__(6) friends or relatives
__(7) restaurant
__(8) personal business
__(9) cocktail/bar/wet party
__(10) other (specify:________________
________________)

67

What was the purpose of this trip?

____

____

Approximately how far was the intended trip (origin to intended destination)?

________________miles

(in kilometers____________)

68 69 70 71

What time did you depart?

________________AM/PM

(24hr. time____________)

72 73 74 75

In-Depth Human Factors Form

How long did you expect the trip to take?

______________________ __ __
76 77

How long a time were you in the car before the accident happened?

______________________ __ __
78 79

86. How long have you been driving in this general area?

STOP

GO TO 03

__________ years

(in months __________)

__ __ __
15 16 17

87. How often do you drive the road on which the accident took place?

__(1) daily
__(2) twice weekly
__(3) once weekly
__(4) twice monthly
__(5) once monthly
__(6) very infrequently
__(7) first time on road

__
18

88. Were you confused in any way by the roadway or control devices?

__(1) Yes (explain: ______________

______________________)

__(2) No

__
19

RESTRAINT USAGE

89. Is your vehicle equipped with adjustable head rests?

__(1) Yes (specify their pre-crash adjusted position ______________

______________________)

__(2) No

__
20

90. Were you wearing a seatbelt at the time of the accident?

__(1) Yes (GO TO ITEM 91)
__No

If NO, which of the following best describes your reason for not using a seatbelt?

__(2) not available
__(3) inconveinent to use
__(4) uncomfortabel
__(5) forgot
__(6) not in habit
__(7) used only when traveling
__(8) don't believe in using them (explain: ______________

______________________)

__(9) other (specify: ______________

______________________)

__ __
21 22

91. Were you wearing a shoulder harness at the time of the accident?

__(1) Yes (GO TO ITEM 92)
__No

If NO, which of the following best describes your reason for not using a shoulder harness?

__(2) not available
__(3) inconvenient to use
__(4) uncomfortable
__(5) forgot
__(6) not in habit
__(7) used only when traveling
__(8) don't believe in using them (explain: ______________

______________________)

__(9) other (specify: ______________

______________________)

__ __
23 24

92. Is your vehicle equipped with a safety belt interlock system?

__(1) Yes (GO TO SPECIAL FORM Page 7A)
__(2) No

__
25

In-Depth Case Number:

Safety Belt Interlock System

Traffic Unit Number:

PART I - VEHICLE INSPECTION

1. Was the interlock system operational before the crash?

__(1) Unknown
__(2) Yes (Disregard remaining questions in Part I)
__(3) No

2. Was any part of the system intentionally defeated?

__(1) Unknown
__(2) Yes
__(3) No (GO TO QUESTION 10)

If intentionally defeated, in what manner was it done? ◯ Unknown

3. __Belt buckled behind occupant
4. __Lap belt cut
5. __Shoulder belt cut
6. __Buzzer rendered inoperative
7. __Logic mechanism altered
8. __Logic mechanism by-passed by ignition circuit
9. __Other (explain):____________
10. If questions 1 and 2 were negative, describe failure mode of the system.

____

PART II - DRIVER INTERVIEW

11. Have you or any other person ever attempted to defeat or "get around" any apsect of the starter interlock system? (Including warning buzzer, lights, switches, etc.).

__(1) Unknown
__(2) Yes
__(3) No (GO TO QUESTION 37)

Why was the attempt made to defeat the system? ◯ Unknown

12. __Took too long to start the car
13. __Do not like to wear restraints
14. __Passengers complained about being forced to wear restraints
15. __No objection to wearing restraints, but I will not be forced to do so in my own automobile
16. __Other:____________

How was the system defeated? ◯ Unknown

17. __Unable to defeat the system (GO TO QUESTION 36)
18. __Wired around the system to the starter
19. __Disconnected the buzzer
20. __Shorted the seat sensors
21. __Tied the belts in knots
22. __Permanantly buckled the belts
23. __Tuck the belts under the carpet after starting the car
24. __Buckled the belt behind occupant after starting the car
25. __Cut the shoulder belt
26. __Cut the lap belt
27. __Altered the logic mechanism (If yes, explain):____________
28. Other:____________

Who accomplished this? ◯ Unknown

29. __Driver
30. __Owner (not driver)
31. __Automobile dealer
32. __Garage mechanic
33. __Relative
34. __Friend
35. __Other:____________
36. Why were you unable to defeat the system?

__(1) Unknown
__(2) Too hard to get to
__(3) Did not have proper tools
__(4) Did not know enough about the system
__(5) Other:____________
__(6) N/A

37. How many times has your vehicle failed to start when you went through the normal fastening routine?

____

38. Did you then attempt to defeat the system?

__(1) Unknown
__(2) Yes
__(3) No
__(4) N/A

39. How many times has your vehicle started but then stalled after going through the normal fastening and starting routine?

____

In-Depth Human Factors Form

DRUG/ALCOHOL USAGE

Had you taken any medication or drug other than alcohol within 48 hours of the collision? (Check all that apply!)

◯ None (GO TO ITEM 102)

93. __stimulants - prescriptive/narcotic __ 26

94. __stimulants - nonprescriptive __ 27

95. __depressants - prescriptive/nartic __ 28

96. __depressants - nonprescriptive __ 29

97. __marijuana __ 30

98. __hallucinogens __ 31

99. __antihistamines __ 32

100. __other __ 33

Specify drug name(s), prescription Number(s), recommended dosage(s) and time taken.

NAME	PRESCRIPT.#	DOSAGE	TIME TAKEN
______		______	__/__/__
______	______	______	__/__/__
______		______	__/__/__

REFER TO PHYSICIAN'S DESK REFERENCE (PDR) FOR THE CLASSIFICATION OF A PARTICULAR DRUG

101. In your opinion, did the drug(s) impair your driving ability in any way?

__(1) Yes (explain:____________________
____________________)

__(2) No __ 34

102. Had you consumed any alcoholic beverages within 24 hours of the accident?

__(1) Yes
__(2) No (GO TO ITEM 113) __ 35

How much of the following types of beverages did you consume? (Indicate quantity of each type)

103. __bottles of beer __ __ 36 37

104. __glasses of wine __ __ 38 39

105. __drinks containing hard liquor __ __ 40 41

106. Over what period of time did you consume these beverages?

__(1) one hour
__(2) two hours
__(3) three hours
__(4) four hours
__(5) five hours
__(6) six or more hours
__(7) don't know __ 42

107. How long before the accident did you consume your last drink?

__(1) less than one hour
__(2) 1-2 hours
__(3) 3-4 hours
__(4) 5-6 hours
__(5) more than 6 hours
__(6) don't know __ 43

108. In your opinion, was your drinking in any way involved in the accident?

__(1) Yes
__(2) No (GO TO ITEM 113) __ 44

If YES, in which of the following ways was it related? (Check all that apply!)

109. __impaired physical response __ 45

110. __impaired judgment __ 46

111. __impaired perception __ 47

112. __other (specify:____________________
____________________) __ 48

MISCELLANEOUS

113. Do you normally drive with one or both hands on the steering wheel?

__(1) left hand only
__(2) right hand only
__(3) both hands
__(4) either hand __ 49

In-Depth Human Factors Form

114. Which foot do you normally brake with?

__(1) right foot
__(2) left foot
__(3) either
__ 50

115. Were all of your vehicle's windows and vents closed at the time of the accident?

__(1) Yes
__(2) No
__ 51

116. Did you have your air conditioner, heater, or defroster operating at the time of the accident?

__(1) Yes (specify:______________)
__(2) No
__ 52

117. Do you smoke?

__(1) Yes, but not smoking at the time of accident.
__(2) Yes, and smoking at time of accident.
__(3) No
__ 53

118. Were you wearing sunglasses at the time of the accident?

__(1) Yes
__(2) No
__ 54

119. Were you carrying luggage or cargo in the vehicle at the time of the accident?

__(1) Yes (describe its location and estimate its weight:______________
______________________________)
__(2) No
__ 55

HAVE THE DRIVER FILL OUT THE DRIVER KNOWLEDGE AND DRIVER OPINION QUESTIONNAIRES.

ACCIDENT SUMMARY

120. How did the driver describe the traffic conditions at the time of the accident?

__(1) heavy
__(2) moderate
__(3) light
__(4) no other traffic present
__ 56

121. Did the driver indicate that he/she was in a hurry?

__(1) Yes (explain:______________
______________________________)
__(2) No
__ 57

122. Did the driver indicate that his/her mind was wandering or preoccupied?

__(1) Yes (explain:______________
______________________________)
__(2) No
__ 58

Did the driver report any activity or occurrence inside the car that might have diverted his/her attention from the driving task? (Check all that apply!)

○ no internal distractions

123. __talking __ 59

124. __listening to tape player or radio __ 60

125. __adjusting controls __ 61

126. __smoking __ 62

127. __eating __ 63

128. __other (specify:______________
______________________________) __ 64

Did the driver report anything outside the car that might have distracted his/her attention from the driving task? (Check all that apply!)

○ no outside distractions

129. __other traffic __ 65

130. __pedestrians __ 66

131. __unusual event like loud noise __ 67

132. __driver-selected outside activity __ 68

133. __other (specify:______________
______________________________) __ 69

In-Depth Human Factors Form

Did the driver report anything that might have impaired or blocked his/her view of the area in which the accident took place. (Check all that apply!)

◯ no view obstructions

134. __other traffic __ 70

135. __curve(s) in road or hillcrest __ 71

136. __trees or foliage __ 72

137. __embankment __ 73

138. __roadside structure __ 74

139. __parked vehicle __ 75

140. __other (specify:______________ ______________________________) __ 76

141. How fast did the driver say he was traveling prior to entering the collision sequence?

______________mph __ 77

142. When was the first time the driver perceived the threatening situation? (Approximate distance in feet)

______________feet __ __ __ 78 79 80

143. Pre-crash vehicle movement:

STOP

GO TO 04

__(1) straight ahead
__(2) turning, curve following
__(3) U-turn
__(4) reverse, backing
__(5) lane changing, passing
__(6) parked, stopped
__(7) entering/leaving private driveway - use #4 if backing in
__(8) starting to move
__(9) unknown

__ 15

144. Character of vehicle movement:

__(1) straight ahead
__(2) straight ahead, road turned to left
__(3) straight ahead, road turned to right
__(4) off righthand-side of road
__(5) off righthand-side of lane
__(6) off righthand-side and back again
__(7) veered right
__(8) turned hard right
__(9) off lefthand-side of road
__(10) off lefthand-side of lane
__(11) off lefthand-side and back again
__(12) veered left
__(13) turned hard left
__(14) vehicle stopped
__(15) other (specify:________________ ______________________________)
__(16) unknown

__ __ 16 17

145. Did the driver attempt any kind of evasive action?

__(1) none (GO TO ITEM 147)
__(2) braked only
__(3) steered only
__(4) accelerated only
__(5) braked then steered
__(6) steered then braked
__(7) simultaneously braked and steered
__(8) other (specify:________________ ______________________________)
__(9) unknown

__ 18

146. Did the vehicle respond to the evasive action as the driver expected?

__(1) Yes
__NO
__(2) fishtailed while skidding
__(3) lost steering control while skidding
__(4) lost control/not skidding
__(5) rolled over on roadway without collision
__(6) other (specify:________________ ______________________________)
__(7) unknown

__ 19

147. If evasive action could have been taken but was not, then why not?

__(1) none possible
__(2) delayed reaction
__(3) insufficient time
__(4) misjudgment
__(5) unsure of other driver's action
__(6) panic
__(7) other (specify:________________ ______________________________)

__ 20

In-Depth Human Factors Form

In the driver's opinion, could he have done anything differently that might have prevented or reduced the severity of the accident? (Check all that apply!) ◯ None

148. __could have gone slower or adjusted speed __ 21

149. __could have accelerated to safety __ 22

150. __could have steered to safety __ 23

151. __could have applied brakes differently __ 24

152. __could have been more alert or paid closer attention __ 25

153. __could have signaled for turn, lane change, etc. __ 26

154. __could have signaled other driver with horn __ 27

155. __could have had related vehicle defect corrected or repaired __ 28

156. __could have anticipated a potentially dangerous situation __ 29

157. __other (specify: ________________ ________________) __ 30

158. How fast did the driver say he was traveling at impact?

________ mph __ __ 31 32

159. What were the driver's actions at impact?

__(1) unaware, no action
__(2) braced
__(3) covered face with hands
__(4) other
__ 33

160. What was the driver's post-impact position in the car?

__(1) normal driving position
__(2) thrown from normal driving position
__ 34

161. What were the driver's immediate post-impact actions?

__(1) no action
__(2) exited the vehicle
__(3) moved vehicle off road
__(4) assisted injured persons
__(5) other (specify: ________________ ________________)
__ 35

162. Was an ambulance required for the driver or his/her passengers?

__(1) Yes
__(2) No
__ 36

163. How was the car removed from the scene?

__(1) towed
__(2) driven away
__ 37

164. Who notified the police of the accident's occurrence?

__(1) driver
__(2) other (specify: ________________ ________________)
__(3) don't know
__ 38

165. Driver's opinion of police actions:

__(1) positive
__(2) negative (explain: ________________ ________________)
__(3) no opinion
__ 39

166. Driver's assessment of principal human fault:

__(1) self
__(2) other driver
__(3) pedestrian
__(4) other (specify: ________________ ________________)
__ 40

167. Driver's ranking of relative contribution of human vehicular and environmental factors (rank 1,2,3)

__(1) human __ 41

__(2) vehicular __ 42

__(3) environmental __ 43

In-Depth Human Factors Form

168. Interviewer's general impression of respondent's attitude and demeanor:

__(1) hostile, uncooperative
__(2) suspicious, guarded
__(3) causal, impersonal
__(4) friendly, cooperative

__ 44

ENTER TEST SCORES WHERE APPLICABLE

169. __Driver Knowledge Test __ __ 45 46

170. __Pelz-Schuman Driver Opinion Questionnaire __ __ 47 48

171. __MAST __ __ 49 50

Describe anything that occurred during the interview that you think may have influenced the accuracy or completeness with which the respondent answered the questions.

____

____

____

____

Is there anything that you can add about his/her driving practices, his/her attitudes and his/her environment which may not be clear from the questionnaire? Please include any impressions that might help us do a better job of analyzing this accident.

____

____

____

____

NOTES:

____

____

____

____

____

____

____

____

In-Depth Human Factors Form: Status Review

TO THE INVESTIGATOR: Place a check mark (✓) in the appropriate square to the right of each attachment item to indicate its status. Be certain to code the in-depth case number and traffic unit number at the top of the 1st page of each supplementary form!

ATTACHMENT ITEM	Page(s)	Array	Card	From Column	To Column	Completed	Pending	Not Completed
Safety Belt Interlock System	7A	52	01	15	54			
Occupant Factors Form	A-1,2	24	01 02	15 15	80 49			
Driver Knowledge Test	B-1,2	53	01	15	34			
Pelz-Schuman Driver Opinion Questionnaire	C-1,3	50	01	15	64			
Dynamic Vision Test	D-1,2	54	01 02	15 15	75 32			
Michigan Alcohol Screening Test (MAST)	N/A	N/A	N/A	N/A	N/A			

TO THE CODERS:

Completed status means the data or tests are present and the results have been entered on the page(s) indicated, if applicable.

Pending status indicates that while the data is not yet in the file, it is expected to be Completed at some later time. The respective arrays should be left blank.

Not Completed status means that the particular data item was either not ascertained or inapplicable. Do not code the associated array for this traffic unit.

The data contained in each Attachment will be keypunched as a separate array beginning and ending in the card columns indicated. The data on the attached page(s) also applies to the traffic unit indicated on page one. Therefore, in keypunching the header information, only the array number will change.

In-Depth Human Factors Form
Occupant Information

In-Depth Case Number:

Traffic Unit Number:

Fill in the chart using the appropriate codes from below.
(Enter any additional information on back of page)

OCC. No.	SEAT POSITION	RE-STRAINTS USED	RE-STRAINTS AVAILABLE	AGE	SEX	AIS	HEIGHT	WEIGHT	AREAS OF OCCUPANT CONTACT
1									
2									
3									
4									
5									
6									
7									
8									
9									

SEX
1=Male
2=Female

Seated Position
01=Left front
02=Center front
03=Right front
04=Left rear
05=Center rear
06=Right rear
07=Left third seat
08=Center third seat
09=Right third seat
10=Bed of truck
11=Inside pickup camper
12=Other
13=Unknown

RESTRAINTS USED AND AVAILABLE
1=None
2=Lap belt only
3=Shoulder belt only
4=Lap and Shoulder belt
5=Unknown

AIS
0=No injury
1=Minor
2=Moderate
3=Severe injuries (not life-threatening)

AIS cont.
4=Severe injuries (life-threatening, survival probable)
5=Critical injuries
6=Fatality (one fatal lesion)
7-8-9: Review AMA codes
10=Unknown

CODES FOR AREAS OF OCCUPANT CONTACT

00=Unknown
01=Air conditioning or ventilation outlets
02=Glove compartment area
03=Hardware items (ashtray, instruments, knobs, etc.)
04=Heater or AC ducts
05=Instrument panel
06=Mirrors
07=Parking brake
08=Radio
09=Steering assembly
10=Sunvisors & fittings, and/or top molding (header)
11=Transmission selector lever
12=Windshield
13=Armrests
14=A-pillar
15=B-pillar

AREAS OF CONTACT CONT.

16=C-pillar
17=D-pillar
18=Courtesy lights
19=Hardware (sides)
20=Surface of side interiors
21=Window frames
22=Window glass
23=Backlight (rear window)
24=Coat hooks
25=Roof or convertible top
26=Roof side rails
27=Console
28=Foot controls
29=Back of seats
30=Head restraints
31=Interior loose object
32=Other occupants
33=Restraint system hardware
34=Restraint system webbing
35=Hood
36=Objects exterior to car
37=Outside surface of car
38=Other
39=Backlight header
40=Other occupants
41=Flying glass
42=Tapedecks
43=Road surface
44=Eye glasses
45=Floors
50=No contact

In-Depth Human Factors Form

Occupant No.________________

1. This form should be filled out for each injured occupant. Add additional forms if necessary.
2. Check boxes to indicate type of injury to each body region, if known.
3. If you are reasonably assured that one or more specific components or areas contacted by this occupant resulted in an associable injury enter the proper code(s) in the starred (*) section. (See page A ((occupant injury)) for codes)
4. Describe specific occupant injuries on the back of this sheet.

BODY REGION	*ENTER CODE(S) FOR AREAS OF POSSIBLE CONTACT				CHECK TYPE OF INJURY									
	1	2	3	4	OVERALL INJURY TO BODY REGION	FRACTURE	LACERATION	CONTUSION	COMPLAINT OF PAIN	ABRASION	CONCUSSION	BURN	HEMORRHAGE	OTHER
Internal Organs														
Brain														
Face														
Head														
Neck (Cervical Region)														
Shoulder Girdle														
Right Upper Limb														
Left Upper Limb														
Chest & Upper Back (Thorax)														
Lower Back (Lumber Region)														
Abdomen														
Pelvic Girdle														
Right Lower Limb														
Left Lower Limb														
Whole Body														

In-Depth Case Number:

In-Depth Human Factors Form
Driver Knowledge Questionnaire

Traffic Unit Number:

Please read each question carefully and select the one response that you feel best answers it. Indicate your choice by placing an "x" in the corresponding blank on its left. Be sure that you answer every question and that you mark one and only one response!

1. Under normal conditions the top speed limit for driving in a business district is:

__(1) 15 mph
__(2) 20 mph
__(3) 25 mph
__(4) 30 mph

__ 15

2. If there are no painted lines on the road you:

__(1) May drive anywhere on your side.
__(2) Should drive as if there were lines.
__(3) Should drive wherever traffic is moving the fastest.
__(4) May drive in the center of the road.

__ 16

3. When driving at dusk or dawn, or on an unusually dark day:

__(1) Turn on your parking lights.
__(2) Keep your sunglasses on to cut down headlight glare.
__(3) Turn your lights on high beam.
__(4) Turn your lights on low beam.

__ 17

4. If your brakes are not holding because they are wet, you should:

__(1) Continue driving and they will dry off.
__(2) Keep one foot on the gas and one lightly on the brake until dry.
__(3) Stop on the side of the road and wait for them to dry.
__(4) Don't use your brakes until they are dry.

__ 18

5. For driving on sand or snow, the best forward traction can be attained:

__(1) By letting air out of the rear tires so they are several pounds below.
__(2) By letting air out of the rear tires and adding weight over the driving wheels.
__(3) By simply keeping the tires at their recommended pressure.
__(4) By adding weight over the driving wheels and keeping them at recommend or slightly higher pressure.

__ 19

6. When you want to make a right turn into a driveway you should:

__(1) Avoid stopping on the road.
__(2) Swing to the left before making the turn.
__(3) Signal after you begin to turn.
__(4) Signal the traffic behind you to pass

__ 20

7. If you come to an intersection that is hard to see around because of trees or buildings:

__(1) Proceed as if there was a yield sign at the intersection.
__(2) Stop near the center of the intersection and then continue when it is safe.
__(3) Slow down and blow your horn to warn drivers who cannot see you.
__(4) Stop at the intersection and edge forward slowly.

__ 21

8. The most dangerous time to drive in the rain is:

__(1) Just before the rain starts because it gets dark but most motorists have not slowed down yet.
__(2) Just after the rain starts because the rain mixes with road film making the roads slick.
__(3) After it has rained for about 30 minutes because the rain has washed away all the grit that gives you traction
__(4) Just after the rain stops because other motorists can see again, and start to drive faster but the streets are still wet.

__ 22

9. If brakes are applied continually, such as is necessary when coming down a long, steep grade, they may become very hot. When this happens:

__(1) The brake warning lamp on the dashboard will come on.
__(2) The brakes will loose their stopping ability.
__(3) The brakes will improve in effectiveness; brakes work best when hot.
__(4) The brakes should operate normally, since heat has very little effect on them.

__ 23

In-Depth Human Factors Form
Driver Knowledge Questionnaire

10. If you are driving at high speed and have a blowout, you should:

__(1) Let go of the steering wheel because the car will straighten itself automatically.
__(2) Step hard on the brakes to stop as quickly as possible.
__(3) Apply the brakes gently, with extreme caution.
__(4) Pull off the road first then slow down. 24

11. If the rear of your vehicle is skidding to the left you should:

__(1) Move the steering wheel back and forth in a zig-zag pattern.
__(2) Turn the top of your steering wheel to the left.
__(3) Hold your steering wheel from moving until out of the skid.
__(4) Turn the top of your steering wheel to the right. 25

12. If you cannot stop in time before hitting another vehicle, it is best to:

__(1) Gradually slow down and then hit the other vehicle.
__(2) Blow the horn and continue at normal speed.
__(3) Try to steer around the vehicle and avoid braking hard.
__(4) Remove your foot from the gas and put on the brake as hard as possible. 26

13. If you have locked your vehicle's brakes and you are sliding toward another vehicle, you should:

__(1) Attempt to steer around the vehicle.
__(2) Sound your horn and flash your lights.
__(3) Pump your brakes and attempt to steer around the vehicle. 27
__(4) Use your emergency brake.

14. If you know that you will soon be making a turn you should:

__(1) Look well ahead to locate the turning point.
__(2) Blow the horn several hundred feet before you turn.
__(3) Flash your bright lights to warn other traffic.
__(4) Speed up so as to avoid making other vehicles wait. 28

15. If the signal at a railroad crossing does not indicate that a train is coming you should:

__(1) Speed up and cross the track quickly.
__(2) Continue at the same speed and check for a train before crossing.
__(3) Slow down and look both ways.
__(4) Come to a complete stop before continuing across. 29

16. When passing a vehicle you should return to the right side of the road when:

__(1) You are 50 feet in front of the passed vehicle.
__(2) The other driver signals you to do so.
__(3) You have cleared the front bumper by a vehicle length.
__(4) You can see its entire front end in your rearview mirror. 30

17. It is best to check tire pressures:

__(1) After the car has been parked for a long time and the tires are "cold".
__(2) After the car has been driven vigorously and the tires are "hot".
__(3) Whenever convenient; it doesn't matter if the tires are hot or cold.
__(4) With the car on a lift, so that there is no weight on the tires. 31

18. When driving through fog at night, you should use your:

__(1) High beam headlights.
__(2) Parking lights.
__(3) Low beam headlights. 32
__(4) 4-way flashers.

19. Before leaving the road to avoid a head-on crash you should slow down by:

__(1) Pumping the brakes.
__(2) Applying constant pressure on the brakes.
__(3) Turning off the engine. 33
__(4) Shifting into neutral.

20. At night you should drive slow enough to be able to stop within:

__(1) 5 car lengths.
__(2) The distance lighted by your headlights.
__(3) The time it takes for a light to change from yellow to red.
__(4) 10 seconds from the time you hit the brake. 34

In-Depth Human Factors Form
Driver Opinion Supplement
Array 50

In-Depth Case Number: Traffic Unit Number:

DOS ONLY

1. What is your cummulative grade-point average (GPA) as a student?

__(1) A
__(2) B
__(3) C
__(4) D
__(5) Don't know

__(6) Check here if you are a high school graduate

15

Most drivers have to take a chance now and then -- such as passing on a winding road, driving fast on a wet road, or turning left in front of oncoming traffic.

Some drivers will be more likely to take a chance when other people are in the car; some drivers will be more likely to take a chance when driving alone. How about you?

CIRCLE ONE ANSWER IN EACH LINE

	More likely to take a chance	Less likely to take a chance	Same as alone	Don't drive with such a person	Never take chances	DOS ONLY
2. With a friend(s) in the car	1	2	3	4	5	16
3. With a date (or wife/ husband	1	2	3	4	5	17
4. With a parent(s) in the car	1	2	3	4	5	18

In this research we want to find out how people actually drive. Listed below are many things that people sometimes do when they drive. As you think back over the past month (or typical month), about how often would you estimate that you did each of these things?

CIRCLE ONE ANSWER IN EACH LINE

	Not at all	Once or twice	Each week	Almost daily	No idea	DOS ONLY
5. Drove with a radio or stereo on (or check here if no radio __)	1	2	3	4	5	19
6. Drove with one hand on wheel	1	2	3	4	5	20
7. Drove through a yellow light	1	2	3	4	5	21
8. Had a friendly race with another car	1	2	3	4	5	22
9. Kept up with traffic that was going 10 mph over the speed limit	1	2	3	4	5	23
10. Drove 15 mph or more over the prevailing traffic inside the city	1	2	3	4	5	24
11. Drove 10 mph or more over the prevailing traffic on an open highway	1	2	3	4	5	25
12. Dared or took a dare from another car	1	2	3	4	5	26

... Continued on next page ...

In-Depth Human Factors Form
Driver Opinion Supplement

DOS ONLY

In addition to driving at different times of day, and on different kinds of roads, people also drive when they are in different states of mind.

Again think of the past month, or if that was very different from your usual driving, think of a typical month. How often in that month did you drive in each state of mind listed below? A rough estimate is okay.

CIRCLE ONE ANSWER IN EACH LINE

	Not at all	Once or twice	Each week	Almost daily	No idea	
13. When I was tired or sleepy	1	2	3	4	5	__ 27
14. When I was in a hurry	1	2	3	4	5	__ 28
15. When I felt worried or depressed	1	2	3	4	5	__ 29
16. In order to get away from people and be on my own	1	2	3	4	5	__ 30
17. When I was smoking	1	2	3	4	5	__ 31
18. When I was angry	1	2	3	4	5	__ 32
19. After a couple of drinks	1	2	3	4	5	__ 33

In a typical week last month, please estimate roughly how much time you spend driving for each of the following purposes (where you were the driver, not a passenger). Write your answer in hours. If you did no driving for some purpose, write "0". (Not time just sitting in the car, or at a store or a movie, but actually driving.)

Hours per week (rough estimate)

20. Driving to or from work, or as part of my job ______________ Hrs. __ __ __ 34 35 36

21. Driving to or from school ______________ Hrs. __ __ 37 38

22. For recreation, shopping visiting, etc. ______________ Hrs. __ __ __ 39 40 41

23. Sum of these = TOTAL HOURS driving per week ______________ Hrs. __ __ __ 42 43 44

Besides the time you were actually driving to and from places such as to work, school, stores, etc., how much time did you spend in an average recent week in these ways?

Hours per week

24. Working on cars (my own, or friends') -- repairing, testing, cleaning, etc. ______________ Hrs. __ __ __ 45 46 47

25. Being in an around cars for fun and entertainment such as at drive-ins, with friends, etc. ______________ Hrs. __ __ 48 49

Sum of these . . . . ______________ Hrs. __ __ __ 50 51 52

... Continued on next page ...

In-Depth Human Factors Form
Driver Opinion Supplement

DOS ONLY

Within the past year, how often have you felt or done the following things?

CIRCLE ONE ANSWER IN EACH LINE

	Not at all	Once or twice	Every month	Every week	Almost daily	DOS ONLY
26. Been mad enough to feel like smashing something, but didn't	1	2	3	4	5	53
27. Been mad enough so I actually did smash something	1	2	3	4	5	54
28. Felt like getting into a fist fight with someone but didn't	1	2	3	4	5	55
29. Actually got into a fight and hit somebody	1	2	3	4	5	56

At present, how much of the time do you feel pressure from other people who are trying to tell you how to run your life?

CIRCLE ONE ANSWER IN EACH LINE

Pressure From:	Hardly ever	Once in a while	Some of the time	Most of the time	Almost always	DOS ONLY
30. My parents or other older relatives	1	2	3	4	5	57
31. My wife (husband) or girlfriend (boyfriend)	1	2	3	4	5	58
32. Friends or relatives my own age	1	2	3	4	5	59
33. People who have authority over me	1	2	3	4	5	60

Sometimes, after an argument or quarrel, people go out for a drive to help them "blow off steam." During the past three months, how often have you gone driving to blow off steam after an argument?

CIRCLE ONE ANSWER IN EACH LINE

How often in three months:

After an argument with:	Not at all	Once or twice	Every month	Every week	Almost daily	DOS ONLY
34. My parent or other older relative	1	2	3	4	5	61
35. My wife (husband) or girlfriend (boyfriend)	1	2	3	4	5	62
36. One of my friends or relatives my own age	1	2	3	4	5	63
37. People who have authority over me	1	2	3	4	5	64

END, THANK YOU!

In-Depth Human Factors Form
Dynamic Vision Test

5 5 4 — 01 02 03 — Duplicate columns 04-14 from page 1 from Array 55.

In-Depth Case Number:

Tr[illegible] Number:

1. Static Acuity--No Glare: Normal

R	L	B	L	B	T
175	150	125	100	85	70
T	L	R	T	L	B
R	L	B	R	B	R
L	T	T	B	T	L
R	B	L	T	B	R
L	R	B	L	R	T
B	R	T	T	L	R

....

___ ___ ___ (15 16 17)

T	B	L	B	L	R	L	T	R
85	70	60	50	40	35	30	25	20
L	B	T	L	T	B	T	R	B
B	R	B	R	B	R	R	R	L
T	L	L	T	L	T	L	B	R
B	R	R	B	T	T	R	T	T
R	T	B	L	R	L	L	L	B
L	R	L	T	B	B	B	T	R

2. Central Angular Movement

(Practice: R L)

256	L	R
128	R	L
64	R	L
32	L	R
16	R	L
12	L	R
8	L	R
6	R	L
4	R	L
2	L	R

TOTAL: ___ ___ (18 19)

THRESHOLD: ___ ___ ___ (20 21 22)

3. Central Movement In-Depth

190	L	L
128	L	S
64	S	L
32	S	L
16	L	S
12	L	S
8	S	L
6	S	L
4	S	L
2	L	S

TOTAL: ___ ___ (23 24)

THRESHOLD:

SMALL: ___ ___ ___ (25 26 27)

LARGE: ___ ___ ___ (28 29 30)

4. Peripheral Angular Movement

(Practice: R L)

	Left Eye	Right Eye
256	L	R
128	R	L
64	R	L
32	L	R
16	R	L
12	L	R
8	L	R
6	R	L
4	R	L
2	L	R

TOTAL: ___ ___ (31 32)

THRESHOLD: ___ ___ ___ (33 34 35)

5. Peripheral Movement In-Depth

	Right Eye	Left Eye
190	L	L
128	L	S
64	S	L
32	S	L
16	L	S
12	L	S
8	S	L
6	S	L
4	S	L
2	L	S

TOTAL: ___ ___ (36 37)

THRESHOLD:

SMALL: ___ ___ ___ (38 39 40)

LARGE: ___ ___ ___ (41 42 43)

6. Peripheral Movement Tone Count

(Subtract total number of tones sounded in BOTH items 4 and 5 above from 40 and enter the resultant score in the columns to the right)

___ ___ (44 45)

7. Static Acuity--No Glare: Low Level

R	L	B	L	B	T
175	150	125	100	85	70
T	L	R	T	L	B
R	L	B	R	B	R
L	T	T	B	T	L
R	B	L	T	B	R
L	R	B	L	R	T
B	R	T	T	L	R

....

___ ___ ___ (46 47 48)

T	B	L	B	L	R	L	T	R
85	70	60	50	40	35	30	25	20
L	B	T	L	T	B	T	R	B
B	R	B	R	B	R	R	R	L
T	L	L	T	L	T	L	B	R
B	R	R	B	T	T	R	T	T
R	T	B	L	R	L	L	L	B
L	R	L	T	B	B	B	T	R

In-Depth Human Factors Form
Dynamic Vision Test

ORDER	8. Field of Vision Left Eye	8. Right Eye	9. Detection, Acquisition, & Interpretation 90° Angle Left Eye	9. Right Eye	10. Detection, Acquisition, & Interpretation 35° Angle Left Eye	10. Right Eye
1	L70		T70		R10	
2		R70		R70		L10
3	L90		L90		R20	
4	L70		L70		L30	
5		R80		T80		B15
6		R90		B90		R20
7	L80		R80		T15	
8		R90		L90		L35
9	L60		B60		B25	
10	L90		T90		R35	
11		R60		R60		B25
12		R70		L70		T30
13		R80		B80		L35
14	L80		R80		T35	
TOTAL	__ 49	__ 50	__ 55	__ 56	__ 61	__ 62
THRES HOLDS	__ 51 __ 52	__ 53 __ 54	__ 57 __ 58	__ 59 __ 60	__ 63 __ 64	__ 65 __ 66

11. Dynamic Visual Acuity 120° Angle

R	T	B	L	R	T	L	L	T	B	R
200	175	150	125	100	85	70	60	50	40	30

__ __ __
67 68 69

12. Static Acuity--Veiling Glare

R	L	B	L	B	T
175	150	125	100	85	70
T	L	R	T	L	B
R	L	B	R	B	R
L	T	T	B	T	L
R	B	L	T	B	R
L	R	B	L	R	T
B	R	T	T	L	R

__ __ __
70 71 72

T	B	L	B	L	R	L	T	R
85	70	60	50	40	35	30	25	20
L	B	T	L	T	B	T	R	B
B	R	B	R	B	R	R	R	L
T	L	L	T	L	T	L	B	R
B	R	R	B	T	T	R	T	T
R	T	B	L	R	L	L	L	B
L	R	L	T	B	B	B	T	R

13. Static Acuity--Spot Glare

R	L	B	L	B	T
175	150	125	100	85	70
T	L	R	T	L	B
R	L	B	R	B	R
L	T	T	B	T	L
R	B	L	T	B	R
L	R	B	L	R	T
B	R	T	T	L	R

__ __ __
73 74 75

T	B	L	B	L	R	L	T	R
85	70	60	50	40	35	30	25	20
L	B	T	L	T	B	T	R	B
B	R	B	R	B	R	R	R	L
T	L	L	T	L	T	L	B	R
B	R	R	B	T	T	R	T	T
R	T	B	L	R	L	L	L	B
L	R	L	T	B	B	B	T	R

STOP

GO TO 02

14. Simple Reaction Times

Trial Number One __ __ __ (15 16 17)

Trial Number Two __ __ __ (18 19 20)

Trial Number Three __ __ __ (21 22 23)

15. Complex Reaction Times

Trial Number One __ __ __ (24 25 26)

Trial Number Two __ __ __ (27 28 29)

Trial Number Three __ __ __ (30 31 32)

In-Depth Vehicle Data Form

In-depth Case Number D-______ Unit Number ____ Date of Accident ___/___/___ Time ________ Hours

Inspector ______________________ Date of Inspection ___/___/___ Time ________ Hours

Location of Inspection: ____IRPS Inspection Facility; (other) ______________

Disposition of Vehicle ______________________ Date ___/___/___

Additional Forms Included: ____Level 2 Inspection; ____Seat-belt/Ignition Interlock

Date Notes Completed ___/___/___

Phase and Array Number	5 4 2	1 2 3
Number of Traffic Units	__ __	4 5
On-Site, In-Depth Flag	2	6
On-Site Case Number	__ __ __ __	7 8 9 10
Traffic Unit Number	__ __	11 12
Card Number	0 1	13 14

IDENTIFICATION

1. Vehicle Type (ISP)

__(01) passenger car
__(04) truck
__(10) taxicab
__(*) other ______________ __ __ 15 16

2. *Make ______________

3. Model ______________ __ __ __ 17 18 19

4. Model year ______________ __ __ 20 21

5. Number of doors ______________ __ 22

6. Body Style

__(0) sedan
__(1) hard top, fastback, hatchback
__(2) station wagon
__(3) convertible
__(4) van
__(5) pick-up truck
__(6) utility vehicle __ 23

*Indicates "code to be inserted by analysis group".

7. Vehicle class (IRPS Code)

__(2) Full size (Buick Electra, Chevrolet Bel Air, etc.)
__(3) Intermediate (Chevelle, Charger, etc.)
__(4) Compact (Dart, Nova, etc.)
__(5) Subcompact (Vega, VW, etc.)
__(6) Sports car (MG, Corvette, etc.)
__(7) Light truck (Pickup, Van)
__(8) Multipurpose Utility Vehicle (e.g., Jeep, Scout, Blazer, etc.)
__(9) Other (bicycle, etc.) __ 24

8. Colors

(Place a "T" adjacent to the top or upper color if it is different from the rest of the vehicle. Place a check mark adjacent to the body color.)

__(1) White
__(2) Black
__(3) Brown
__(4) Orange
__(5) Blue
__(6) Green
__(7) Yellow
__(8) Red
__(9) Gray
__(10) Gold
__(11) Beige
__(12) Bronze
__(13) Purple
__(14) Turquoise
__(15) Tan — Upper __ __ 25 26
__(16) Burgandy
__(17) Pink
__(18) Other ______________ — Lower __ __ 27 28

9. License

Number ______________

State ______________

Year ______________

In-Depth Vehicle Data Form

10. Vehicle Identification Number (VIN)

____

11. Recent maintenance

Date ___/___/___ ____unknown

Mileage ______________

(Check all that were performed)

__oil changed ____unknown
__oil filter changed
__lubed
__tuned-up
__other ____________________

12. Inspection decal information

__(0) unknown
__(1) valid Indiana inspection
__(2) valid (show other state) __________ inspection
__(3) not required by (show other state) __________
__(4) expired
__(5) other violation __________ __ 29

____

Date ___/___/___

Mileage ____________ : __ __ __ __ __ __ 30 31 32 33 34 35

13. Odometer reading at time of inspection.

____________ : __ __ __ __ __ __ 36 37 38 39 40 41

On-site odometer reading ________________

INTERIOR, LIGHTS, AND VISION - LEVEL 1

The main purpose of this part of the inspection is to determine the pre-crash condition of certain components of the vehicle. If the pre-crash condition of a component cannot be determined, check the blank provided and circle the appropriate letters from the code which follows:

NE = Not Equipped with this specific component.

CNC = Could Not Check this component either due to damage to other related components (e.g., could not check headlights because the battery was damaged) or due to lack of time or proper tools.

CD = Crash Damaged. This component was or may have been, damaged such that its original pre-crash condition cannot be determined.

If a component was defective in anyway and the defect might have played a causative role in the accident, circle the check mark.

14. Windshield

Type

__clear
__tinted

Condition (check the most important one)

__(0) CD
__(1) pass - go to block 15
__(2) stickers which might block driver's view
__(3) stars or chips larger than a quarter
__(4) cracks
__(5) clouded areas
__(6) windshield wiper scratches
__(7) dirt, ice, snow or fog covered
__(8) other ______________ __ 42

Location of Defect

distance from left edge ____in. (____cm)

distance from top edge ____in. (____cm)

Size of Defect

height ________in. (________cm)

width ________in. (________cm)

15. Rear Window (check the most important one)

__(0) NE, CD
__(1) pass - go to block 16
__(2) stickers which might have blocked driver's view
__(3) stars or chips larger than a quarter
__(4) cracks
__(5) clouded areas
__(6) dirt, ice, snow or fog covered
__(7) other ______________

Location of Defect

distance from left edge ____in. (____cm)

distance from top edge ____in. (____cm)

Size of Defect

height ________in (________cm)

width ________in (________cm)

In-Depth Vehicle Data Form

16. Other glass

__(0) CD
__(1) pass
__(2-7) defective (indicate number code from previous question)

Sketch the defect and the adjacent windows and indicate left or right side views from outside the vehicle.

17. Vision obstructions

__(0) CNC
__(1) pass (no obstructions)
__(2) obstruction present (sketch below)

18. Mirror, interior

__(0) NE, CD (NE can apply only when vehicle has no rear window or rear window is permanently blocked)
__(1) pass
__(2) missing
__(3) broken glass
__(4) loose
__(5) improperly adjusted
__(6) other________________________

19. Mirror, left exterior

__(0) CD (NE cannot apply)
__(1) pass
__(2) missing
__(3) broken glass
__(4) loose
__(5) improperly adjusted
__(6) other________________________

20. Mirror, right exterior

__(0) NE, CD (NE cannot apply when vehicle has no rear window or rear window is permanently blocked)
__(1) pass
__(2) missing
__(3) broken glass
__(4) loose
__(5) improperly adjusted
__(6) other________________________

21. Horn

__(0) CNC, CD
__(1) pass
__(2) does not function
__(3) other________________________

22. Brake pedal behavior

__(0) CNC, CD
__(1) pass
__(2) insufficient reserve
__(3) rapid onset & sustained
__(4) slow onset and sustained
__(5) light and sustained
__(6) other (explain:________________

____________________________) __ 43

23. Pedal rubbers

(0) NE, CNC, CD
(1) pass
(2) slick surface, missing rubber
(3) loose rubber
(4) pedal missing
(5) metal traction surface, worn smooth
(6) other________________________

Indicate code number

clutch ________________________
brake ________________________
accelerator ________________________

24. Control obstructions, pedals

__(0) CNC
__(1) pass (no obstructions)
__(2) floor mats
__(3) wires, fittings
__(4) litter
__(5) other (explain:________________

____________________________) __ 44

25. Control obstructions, steering

__(0) CNC
__(1) pass (no obstructions)
__(2) loose steering wheel cover
__(3) steering wheel spinner
__(4) other (explain:________________

____________________________) __ 45

26. Control modifications

__(0) no modification
__(1) modified, positive effect
__(2) modified, neutral effect
__(3) modified, negative effect
__(4) modified, unknown effect

Explain________________________

____

________________________________ __ 46

In-Depth Vehicle Data Form

27. Interior modifications

___(insert code number from question 26) ___ 47

Explain______________________________

____

____

28. Vision related modifications

___(insert code number from question 26) ___ 48

Explain______________________________

____

____

29. Glare producing surfaces

__(0) CNC
__(1) pass
__(2) glare producing surfaces present

Explain______________________________

____

____

30. Defroster function

circle if defroster was needed

__(0) CNC, CD
__(1) pass
__(2) does not function
__(3) functions, but inadequate
__(4) other______________________________

31. Windshield washer function

circle if washer was needed

__(0) CNC, CD
__(1) pass
__(2) does not function
__(3) functions, but improperly aimed
__(4) functions on only one side L, R
__(5) other______________________________ ___ 49

32. Windshield wiper function

circle if wipers were needed

__(0) CNC, CD
__(1) pass
__(2) functions on left side only
__(3) functions on right side only
__(4) does not function on either side
__(5) other______________________________ ___ 50

Condition

circle if wipers were needed

__(0) CD
__(1) pass
__(2) left wiper blade does not clear window completely
__(3) right wiper blade does not clear window completely
__(4) does not clear window completely on either side
__(5) other______________________________ ___ 51

Park

__(0) CNC, CD
__(1) pass
__(2) left wiper does not park properly
__(3) right wiper does not park properly
__(4) neither wiper parks properly
__(5) other______________________________

Sketch the position of wiper below:

33. Brake failure warning lamp

__(0) NE, CNC, CD
__(1) pass (circle if lamp is correctly indicating a malfunction of the brake system)
__(2) lamp does not function (circle if a malfunction of the brake system is present)
__(3) lamp stays on and is a false signal
__(4) other______________________________

34. Stop lights

Left	Right	
____	____	(0) CNC, CD
____	____	(1) pass
____	____	(2) does not light when brake is applied
____	____	(3) stays on when brake is released
____	____	(4) lens broken or missing
____	____	(5) lens obscured
____	____	(6) other______________

L R

52 53

In-Depth Vehicle Data Form

35. Turn indicators

Function

LF	LR	RR	RF	
__	__	__	__	(0) CNC, CD (NE cannot apply
__	__	__	__	(1) pass
__	__	__	__	(2) does not light
__	__	__	__	(3) lights, but does not flash
__	__	__	__	(4) flashes too fast
__	__	__	__	(5) not equipped
__	__	__	__	(6) lens obscured
__	__	__	__	(7) other________

LF LR RR RF

__ __ __ __
54 55 56 57

Control

left	right	
____	____	(0) CNC, CD
____	____	(1) pass
____	____	(2) does not automatically cancel
____	____	(3) does not hold in turn position
____	____	(4) control missing
____	____	(5) other________________

L R

__ __
58 59

Side Visibility

Side visibility should be determined by standing ten feet from the vehicle and on line with the front or rear axle.

LF	LR	RR	RF	
__	__	__	__	(0) CNC, CD (NE cannot apply)
__	__	__	__	(1) pass
__	__	__	__	(2) does not light, but ordinarily visible
__	__	__	__	(3) lights, but does not flash
__	__	__	__	(4) flashes too fast
__	__	__	__	(5) signals not visible, not equipped
__	__	__	__	(6) lens obscured
__	__	__	__	(7) other____________

LF LR RR RF

__ __ __ __
60 61 62 63

36. Restraints available

Type

(0) NE, CNC
(1) lap belt only
(2) lap/shoulder, not separable
(3) lap/shoulder, separable
(4) lap.shoulder, separate buckles
(5) air cushion with lap belt
(6) air cushion only
(7) special child restraint (explain________
____
____________________________________)

__(8) modified original equipment (explain____
____
____________________________________)

Place the appropriate code in each seat position. Place an "X" in the space if no seat position is provided.

Left	Center	Right

(Sketch in additional seats if present)

Auxiliary Equipment

check all that apply

__inertia reels
__pendulum-lock reels
__retractors, simple
__ratchet lock retractors
__ignition interlock system

In-Depth Vehicle Data Form

37. Head restraints available

__(0) NE, CNC
__(1) adjustable type
~~__(2) non-adjustable, integral type~~

If possible, ask driver if position has been changed since accident.

Total Height

left ___in. (___cm) LEFT: __ __ 64 65

right ___in. (___cm) RIGHT: __ __ 66 67

38. Padded components

check all that apply

__(0) NE
__(1) dash, upper
__(2) dash, lower
__(3) sun visors
__(4) arm rests
__(5) door panels
__(6) steering wheel hub
__(7) steering wheel spokes
__(8) steering wheel rim
__(9) other___________________

End of INTERIOR, LIGHTS, AND VISION - LEVEL 1. Complete Level 2 at this time if there is any reason to believe that additional defects exist, which may have played a causative role in this accident.

ENGINE COMPARTMENT AND STEERING -LEVEL 1

39. Engine data

displacement_______cubic inches (__________cc)

number of cylinders___________________

number of carburetors___________________

number of barrels each___________________

horsepower___________________

40. Master cylinder

Type

__dual chamber
__single chamber

Fluid Level

__(0) CNC, CD
__(1) pass (all chambers at least 1/2 full)
__(2) one or both chambers less than 1/2 full (continued)

(circle if any chamber is empty)

Explain___________________

____

Power Assisted

__not power assisted
__vacuum power assisted
__hydraulic power assisted

Servo Function

CHECK TO SEE IF IT IS SAFE TO START ENGINE. Deplete vacuum or hydraulic reserve by depressing brake several times with engine off. Hold pedal down and start engine. Pedal will fall away slightly if servo is functioning properly.

__(0) NE, CNC, CD
__(1) pass
__(2) servo does not function due to hose defect
__(3) servo does not function due to other reasons (explain if known___________________

___________________)

41. Engine mounts

__(0) CNC, CD
__(1) pass
__(2) one or more engine mounts broken (explain__

___________________)

Circle if secondary affects (control problems) are likely.

42. Exhaust system

Function

__(0) CNC, CD
__(1) pass, no leaks and exhaust is discharged at the side or rear of vehicle
__(2) system leaks
__(3) system discharges exhaust gases under vehicle
__(4) other___________________

(explain 2, 3, or 4___________________

___________________)

Modification __ 68

__(0) no modification
__(1) modified, positive affect
__(2) modified, neutral affect
__(3) modified, negative affect
__(4) modified, unknown affect (explain__________

___________________)

In-Depth Vehicle Data Form

43. Automatic transmission

Performance

__(0) NE, CNC, CD
__(1) pass
__(2) defective (explain________________________

____)

Fluid Level

Check with engine running, if possible.

__(0) NE, CNC, CD
__(1) pass
__(2) low more than 1 pint

44. Clutch performance

__(0) NE, CNC, CD
__(1) pass
__(2) defective (explain________________________

____)

45. Manual transmission

Number of gears forward__________

Performance

__(0) NE, CNC, CD
__(1) pass
__(2) defective (explain________________________

____)

46. Steering play

Type

__non power assisted
__power assisted

Play

Check with engine running, if possible, when steering is power assisted.

wheel size _______in (_______cm)

distance at rim _______in (_______cm)

degrees of play_______ __ __ 69 70

__(0) CNC, CD
__(1) pass, 15° or less
__(2) defective more than 15° __ 71

(circle if more than 60° whether steering was involved or not)

If power assisted:

__engine was running
__engine was not running

47. Steering stiff spots

Cycle through full left and full right.

__(0) CNC, CD
__(1) pass, no staff spots
__(2) defective (explain________________________

____)

48. Steering pump

Belt

__(0) NE, CNC, CD
__(1) pass
__(2) loose
__(3) broken
__(4) other________________________

Fluid Level

__(0) NE, CNC, CD
__(1) pass
__(2) less than 1/4 full __ 72

49. Steering box play

__(0) CNC, CD
__(1) pass
__(2) defective, major source of play
__(3) defective, not major source of play __ 73

50. Steering box security

__(0) CNC, CD
__(1) pass
__(2) defective (explain________________________

____)

51. Steering damper

__(0) NE, CNC, CD
__(1) pass
__(2) defective (explain________________________

____)

52. Front dampers

__(0) CNC, CD
__(1) pass
__(2) defective ([illegible]n________________________

____) __ 74

53. Toe VALUE

IN: __ __ 75 76

___in, ___out; ___/32 in. (___mm)
__(0) CNC, CD
__(1) pass OUT: __ __ 77 78
__(2) more than 4/32 in(7.18mm)in
__(3) more than 2/32 in (1.5?mm)out.

ASSESSMENT: __ 79

STOP

In-Depth Vehicle Data Form

JACK UP FRONT END OF VEHICLE

54. Tie rod ends

GO TO 02

__(0) CNC, CD
__(1) pass
__(2) left side tie rod ends loose
__(3) right side tie rod ends loose
__(4) both sides tie rod ends loose
__(5) either side completely disconnected

Explain ______________________________

______________________________ __ 15

55. Idler arm play

__(0) NE, CNC, CD
__(1) pass
__(2) loose

Explain ______________________________

______________________________ __ 16

End of ENGINE COMPARTMENT AND STEERING - LEVEL 1. Complete Level 2 at this time, if there is any reason to believe that additional defects exist, which may have played a causative role in this accident.

WHEELS, TIRES, SUSPENSION, BRAKES - LEVEL 1

56. Wheel bearing play

Left Front

__(0) CNC, CD
__(1) pass
__(2) excessive play __ 17

Right Front

__(0) CNC, CD
__(1) pass
__(2) excessive play __ 18

57. Lower control arm pivots

__(0) CNC, CD
__(1) pass
__(2) excessive play

Explain ______________________________

______________________________ __ 19

58. Upper control arm pivots

__(0) CNC, CD
__(1) pass
__(2) excessive play __ 20

Explain ______________________________

____

59. Tie bars bushings, mounts, bars

__(0) NE, CNC, CD
__(1) pass
__(2) defective

Explain ______________________________

______________________________ __ 21

60. Front anti-roll bar, bushings, mounts, bar

__(0) NE, CNC, CD
__(1) pass
__(2) defective

Explain ______________________________

______________________________ __ 22

61. Front springs

__(0) CNC, CD
__(1) pass
__(2) sag
__(3) broken
__(4) spacers (number__________)
__(5) other______________ __ 23

Explain ______________________________

____

62. Front suspension modification

__(0) no modification
__(1) modified, positive affect
__(2) modified, neutral affect
__(3) modified, negative affect
__(4) modified, unknown affect

Explain ______________________________

______________________________ __ 24

In-Depth Vehicle Data Form

BRAKE DATA

	TYPE	PAD/LINING			MISCELLANEOUS				DISC or DRUM	DRUM				
	Code A	Cond. (0,1,2)	Minimum Thickness[1]	Asses. (0,1,2)	Mech. (0,1,2)	Seal (0,1,2)	Cyl. (0,1,2)	Hose (0,1,2)	Cond. (0,1,2)	Drum Diameter[2]	Asses. (0,1,2)	Lining Diameter	Minimum Clearance[3]	Asses. (0,1,2)
RIGHT FRONT	__ 25	__ 26	________/32in (________cm)	__ 27	__ 28	__ 29	__ 30	__ 31	__ 32	Maximum ______in (_____cm) Minimum ______in (_____cm)	__ 33	______in (_____cm)	______in (_____cm)	__ 34
LEFT REAR	__ 35	__ 36	________/32in (________cm)	__ 37	__ 38	__ 39	__ 40	__ 41	__ 42	Maximum ______in (_____cm) Minimum ______in (_____cm)	__ 43	______in (_____cm)	______in (_____cm)	__ 44

Code A
- 1 = Disc, Riveted
- 2 = Disc, Bonded
- 3 = Drum, Riveted
- 4 = Drum, Bonded

- 0 = CNC
- 1 = Pass
- 2 = Defective

REMARKS:

NOTES:

1. Brake pads must be 4/32 in (3.175mm) or more in thickness, linings must be 1/32 in (0.7935mm) or more above rivet heads, or backing wire must not show if lining is bonded.

2. Drum diameter must not exceed 0.060 in (0.1525cm) over nominal size and must not exceed 0.015 in (0.0381cm) between maximum and minimum diameters.

3. Drum to lining clearance must not exceed 0.050 in (0.1157cm).

In-Depth Vehicle Data Form

63. Limited-slip differential

__(0) not equipped
__(1) equipped

torque__________ ___ 45

64. Rear suspension arm pivots

__(0) CNC, CD
__(1) pass
__(2) defective

Explain______________________

______________________________ ___ 46

65. Rear springs

__(0) CNC, CD
__(1) pass
__(2) sag
__(3) broken
__(4) spacers (number__________)
__(5) other

Explain______________________

______________________________ ___ 47

66. Rear anti-roll bar

__(0) NE, CNC, CD
__(1) pass
__(2) defective

Explain______________________

______________________________ ___ 48

67. Rear suspension modification

__(0) no modification
__(1) modified, positive affect
__(2) modified, neutral affect
__(3) modified, negative affect
__(4) modified, unknown affect

Explain______________________

______________________________ ___ 49

68. Rear dampers

__(0) CNC, CD
__(1) pass
__(2) deficient function (either)

Explain______________________

______________________________ ___ 50

In-Depth Vehicle Data Form

	WHEELS			TIRES											
				CARCASS					TREAD				PRESSURE		
	Cond. (0,1,2)	MOD. Code A	LUGS--# missing	Size	Cond. (0,1,2)	Type Code B	Plies SW--T	Manufacturer	Type Code C	Depth* (/32")	(mm)	Asses. (0,1,2)	Meas. (PSI)	Recom. (PSI)	Asses. (0,1,2)
LEFT FRONT	___	___	___	___	___	__ 51	___	___ ___	___	I___ M___ O___ __ __ 52 53	___ ___ ___	__ 54	__ __ 55 56	___	__ 57
LEFT REAR	___	___	___	___	___	__ 58	___	___ ___	___	I___ M___ O___ __ __ 59 50	___ ___ ___	__ 61	__ __ 62 63	___	__ 64
RIGHT REAR	___	___	___	___	___	__ 65	___	___ ___	___	I___ M___ O___ __ __ 66 67	___ ___ ___	__ 68	__ __ 69 70	___	__ 71
RIGHT FRONT	___	___	___	___	___	__ 72	___	___ ___	___	I___ M___ O___ __ __ 73 74	___ ___ ___	__ 75	__ __ 76 77	___	__ 78

Code A
0 = No modifications
1 = Modified, positive effect
2 = Modified, neutral effect
3 = Modified, negative effect
4 = Modified, unknown effect

Code B
1 = Bias ply
2 = Belted bias ply
3 = Radial ply
4 = Steel belted radial ply

Code C
1 = Regular
2 = Studded regular
3 = Non-studded snow
4 = Studded snow
5 = Racing slick
6 = Other ___________

0 = CNC
1 = Pass
2 = Defective

*CODE Smallest Entry Only!

REMARKS:

STOP

In-Depth Vehicle Data Form

VEHICLE DAMAGE SUMMARY

In-depth investigation requires a careful description of damage, with emphasis on the DEPTH, LOCATION, and DIRECTION OF IMPACT. Please enter a written description as necessary to supplement the attached diagram. Take photographs showing damage.

A. External (Depth, location, direction of impact)

____

____

____

____

____

____

____

____

____

____

B. Internal (Penetrations and stress damage)

____

____

____

____

____

____

____

____

____

____

C. Vehicle Deformation Index: GO TO 03

*Primary VDI: __ __ - __ __ __ __ - __

Secondary VDI: __ __ - __ __ __ __ - __

*DIRECTION OF IMPACT: __ __ (15 16)

*HORIZONTAL LOCATION: __ __ (17 18)

*VERTICAL LOCATION: __ (19)

*TYPE OF DAMAGE: __ (20)

*EXTENT OF DAMAGE: __ (21)

*Indicates "codes to be inserted by analysis group".

NOTE: Take photographs showing vehicle damage and all pertinent defects.

In-Depth Vehicle Data Form

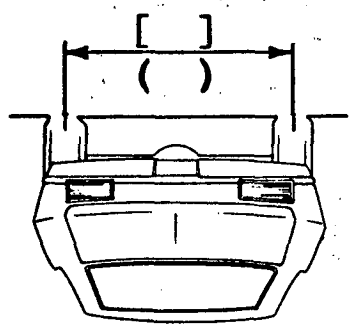
VEHICLE DEMENSIONS AND DAMAGE

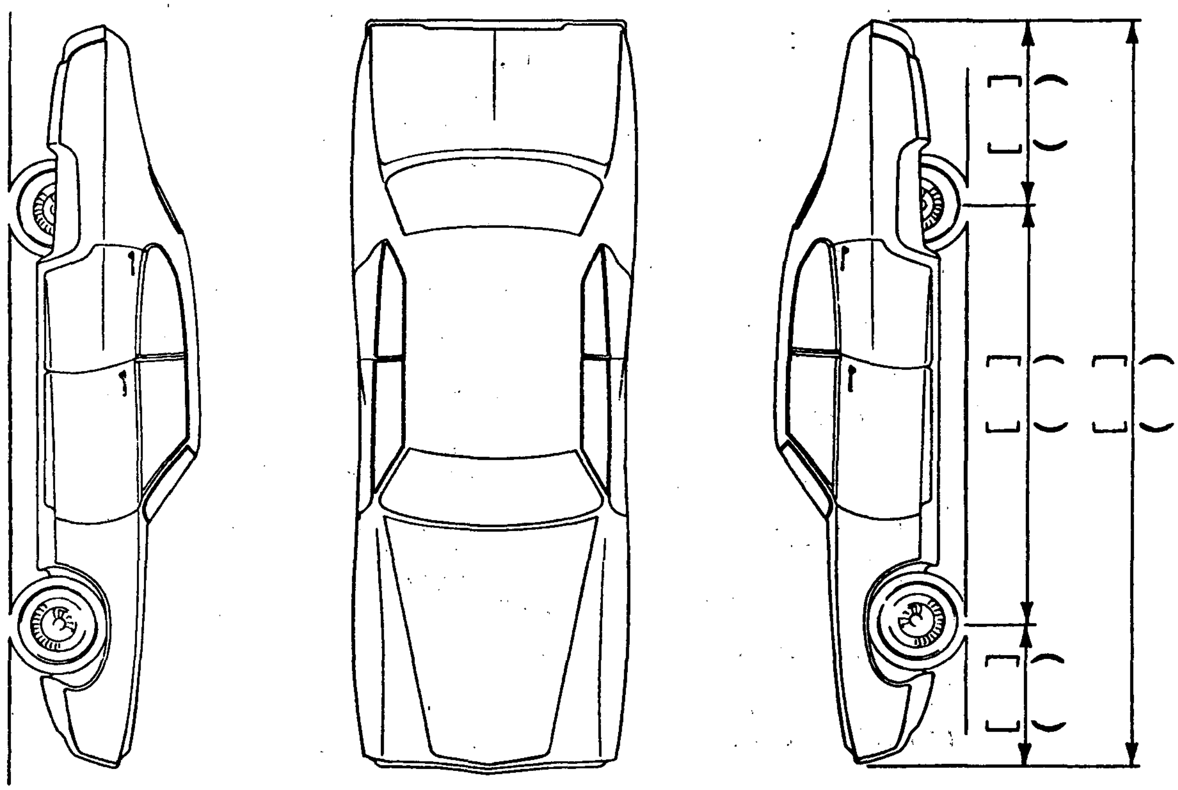
Empty Wt: __________ lbs.

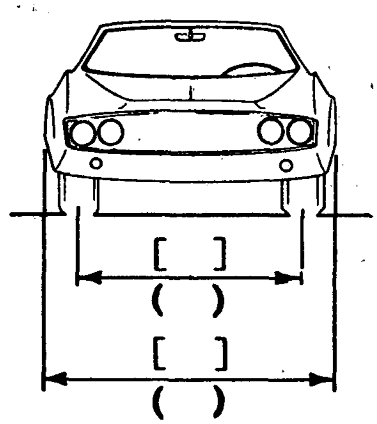
(__________ kg)

Cargo Wt: __________ lbs.

(__________ kg)







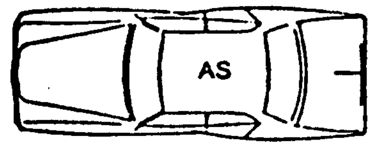
1. Indicate crushed areas by outlining new perimeter of the vehicle and shading the damaged areas.

2. Enter demensions on the sketch(es) measured to the point of maximum penetration by the object(s) contacted.

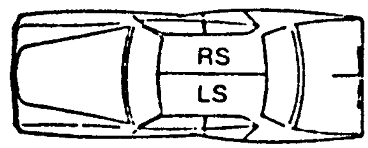
3. Enter origional demensions, in inches, in the bracketed spaces, and the equivalent metric demension in the space below.

In-Depth Vehicle Data Form

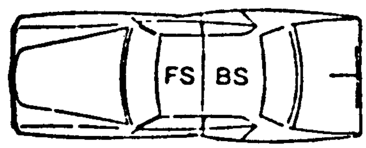
VEHICLE INTERIOR DEFORMATION INDEX



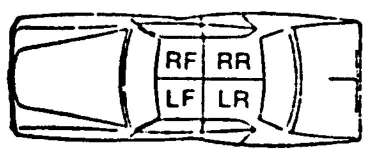
AS ALL SEATS



RS RIGHT SEATS
LS LEFT SEATS



FS FRONT SEATS
BS REAR SEATS



LF LEFT FRONT
LR LEFT REAR
RF RIGHT FRONT
RR RIGHT REAR

VIDI is partly based on the same principles as the VDI and is meant to be used in combination with the VDI.

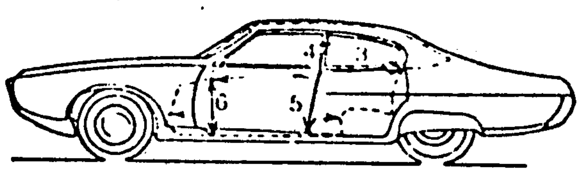
VDI gives a detailed specification of the location and extent of external deformation. VIDI is meant to complete this information regarding the reduction of the passenger compartment.

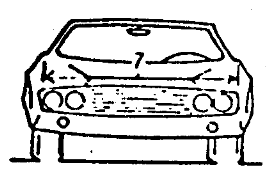
The amount of reduction is given in a 10-degrees linear scale with "0" meaning no reduction, "5" meaning reduction to the half and "X" meaning total reduction.

The location of the reduction is related to the seat/seats concerned.

Col 3-7 are used to indicate the reduction, where:

- **Col 3** means the deformation between the top of the rear seat back rest and the instrument panel (not overhanging padding) or intruding objects
- **Col 4** means the deformation between floor and roof
- **Col 5** means the deformation between the foremost lower part of the rear seat and the fire wall
- **Col 6** means the deformation between the lower part of the instrument panel and the floor
- **Col 7** means the inner width deformation.





VIDI

DEFORMATION SCALE

INDEX COLUMN NO.- 1 2 3 4 5 6 7

In-Depth Vehicle Data Form

TECHNICAL WRITER'S SUMMARY

Power Accessories (pp. 6,7): ____________________

Differential Type (p. 10): ____________________

Padded Components (p. 6): ____________________

Restraints (pp. 5,6): ____________________

Defects: ____________________

In-Depth Vehicle Data Form
Supplement—Level 2

Phase and Array Number 5 4 2

Number of Traffic Units per Accident __ __

On-site, In-depth Flag __

On-site Case Number __ __ __ __

Traffic Unit Number __ __

Card Number N /A

INTERIOR LIGHTS AND VISION - LEVEL 2

1. Highbeam warning lamp

__(0) CNC
__(1) pass
__(2) does not function

2. Dip switch operation

__(0) CNC, CD
__(1) pass
__(3) defective

Explain ______________________________

____

3. 4-way flashers & warning lamps

__(0) NE, CNC, CD
__(1) pass
__(2) defective

Explain ______________________________

____

4. Transmission detents

__(0) NE, CNC, CD
__(1) pass
__(2) does not hold position

Explain ______________________________

____

5. Inhibitor switch

__(0) NE, CNC, CD
__(1) pass
__(2) starter will operate in other than P or N
__(3) other

6. Instrument lights

__(0) NE, CNC, CD
__(1) pass
__(2) does not function (all)

Explain ______________________________

____

7. Rear lights

Function

__(0) CNC, CD
__(1) pass
__(2) defective

Explain ______________________________

____

Lens/Reflector

__(0) CNC, CD
__(1) pass
__(2) defective

Explain ______________________________

____

8. Back-up lights

__(0) NE, CNC, CD
__(1) pass
__(2) defective

Explain ______________________________

____

9. Front parking lights

Function

__(0) NE, CNC, CD
__(1) pass
__(2) defective

Explain ______________________________

____

10. Side markers

Function

__(0) NE, CNC, CD
__(1) pass
__(2) defective

Explain ______________________________

____

Lens/Reflector

__(0) NE, CNC, CD
__(1) pass
__(2) defective

Explain ______________________________

____

11. Headlights

Function

Indicate non functional lights with an "X". Put two horizontal lines through B and C if not present.

High
A D
B C

__(0) CNC, CD
__(1) pass
__(2) defective

Low
A D

__(0) CNC, CD
__(1) pass
__(2) defective

Aim

Enter the measurement from the aiming device in the appropriate blank and circle "l" or "r" and "up" or "down".

__l/r A __up/down __l/r D __up/down

__(0) CNC, CD
__(1) pass
__(2) defective

__l/r B __up/down __l/r C __up/down

__(0) CNC, CD
__(1) pass
__(2) defect

End of INTERIOR, LIGHTS, & VISION - LEVEL 2.
Go to ENGINE COMPARTMENT AND STEERING - LEVEL 1.

ENGINE COMPARTMENT AND STEERING - LEVEL 2

12. Battery connections

__(0) CNC, CD
__(1) pass
__(2) defective

Explain ______________________________

____

13. Main electrical connections

__(0) CNC, CD
__(1) pass
__(2) defective

Explain ______________________________

____

14. Accelerator linkage

__(0) CNC, CD
__(1) pass
__(2) defective

Explain ______________________________

____

15. Carbeurator linkage

__(0) CNC, CD
__(1) pass
__(2) defective

Explain ______________________________

____

16. Choke

__manual
__auto

Position ______________

Explain ______________________________

____

17. Hoses

__(0) CNC, CD
__(1) pass
__(2) defective

Explain ______________________________

____

18. Engine function

__CNC

Idle speed-spec ________ Measure ________
Initial timing-spec ________ Measure ________
Dwell angle-spec ________ Measure ________
Point resistance ________ Measure ________

Rotor___ Cap___ Wires___

End ENGINE COMPARTMENT AND STEERING LEVEL 2.
Go to WHEELS, TIRES, SUSPENSION, AND BRAKES, LEVEL 1.

WHEEL, TIRES, SUSPENSION, AND BRAKES - LEVEL 2

19. Ball joints upper

__(0) NE, CNC, CD
__(1) pass
__(2) defective

left spec____________ measure__________ right spec________ measure______

__load carrying

Explain______________________________

____

20. Ball joints lower

__(0) NE, CNC, CD
__(1) pass
__(2) defective

left spec____________ measure__________ right spec__________ measure_______

__load carrying

Explain______________________________

____

Front Brake Test	LEFT	RIGHT
21. No Load Drag		
22. Brake Force at Pedal Load A		
23. Maximum Imbalance		
Rear Brake Test		
24. No Load Drag		
25. Brake Force at Pedal Load A		
26. Pedal Load A		
27. Maximum Imbalance		
28. Parking Brake		
29. Speedo Accuracy at 46 mph true		

In-Depth Vehicle Data Form

BRAKE DATA

	TYPE	PAD/LINING			MISCELLANEOUS				DISC or DRUM	DRUM				
	Code A	Cond. (0,1,2)	Minimum Thickness[1]	Asses. (0,1,2)	Mech. (0,1,2)	Seal (0,1,2)	Cyl. (0,1,2)	Hose (0,1,2)	Cond. (0,1,2)	Drum Diameter[2]	Asses. (0,1,2)	Lining Diameter	Minimum Clearance[3]	Asses. (0,1,2)
LEFT FRONT	___	___	___/32in (___cm)	___	___	___	___	___	___	Maximum ___in (___cm) Minimum ___in (___cm)	___	___in (___cm)	___in (___cm)	___
RIGHT REAR	___	___	___/32in (___cm)	___	___	___	___	___	___	Maximum ___in (___cm) Minimum ___in (___cm)	___	___in (___cm)	___in (___cm)	___

Code A
1 = Disc, Riveted
2 = Disc, Bonded
3 = Drum, Riveted
4 = Drum, Bonded

0 = CNC
1 = Pass
2 = Defective

REMARKS:

NOTES:

1. Brake pads must be 4/32 in (3.175mm) or more in thickness, linings must be 1/32 in (0.7935mm) or more above rivet heads, or backing wire must not show if lining is bonded.

2. Drum diameter must not exceed 0.060 in (0.1525cm) over nominal size and must not exceed 0.015 in (0.0381cm) between maximum and minimum diameters.

3. Drum to lining clearance must not exceed 0.050 in (0.1157cm).

In-Depth Environmental Form

Phase and Array Number	5 (1) 0 (2) 2 (3)
Number Of: Blank	b (4) b (5)
On-Site, In-Depth Flag	2 (6)
On-site Case Number	__ (7) __ (8) __ (9) __ (10)
Traffic Unit	b (11) b (12)
Card Number	0 (13) 1 (14)

In-Depth Case Number ____________

Completed By ____________

Location ____________

____

DOS Only:
Date Rec'd. ____________

ENVIRONMENTAL DESCRIPTORS

1. Date of Collision
   - Month __ (15) __ (16)
   - Day __ (17) __ (18)
   - Year __ (19) __ (20)

2. Time of Collision __ (21) __ (22) __ (23) __ (24)

3. Temperature __ (25) __ (26) __ (27)
For temperatures less than 0°F place a (-) in column 25

4. Light Conditions
__(1) Day
__(2) Night - Unlighted
__(3) Night - Lighted
__(4) Dawn or Dusk
__ (28)

5. Visibility
__(1) Clear
__(2) Hazy
__(3) Foggy
__ (29)

6. Precipitation
__(1) No precipitation
__(2) Rain
__(3) Sleet/Hail
__(4) Snow
__ (30)

7. Cloud Cover
__(1) Clear
__(2) Partly
__(3) Full
__ (31)

8. Wind Velocity
__(1) Calm
__(2) Moderate
__(3) Hard
__(4) Gusting
__ (32)

9. Wind Direction
__(1) North
__(2) South
__(3) East
__(4) West
__(5) Northeast
__(6) Southeast
__(7) Southwest
__(8) Northwest
__(9) Variable
__ (33) __ (34)

10. Pavement Surface
__(1) Dry
__(2) Wet
__(3) Icy
__(4) Snowy
__(5) Packed Snow
__ (35)

11. Land Use
__(1) Residential
__(2) Commercial
__(3) Industrial
__(4) Agriculture/Vacant Land
__(5) Public Ground and Building
__ (36)

12. Type of Area
__(1) Rural
__(2) Urban
__ (37)

13. Roadway Type
__(1) Divided four-lanes
__(2) Undivided four-lanes
__(3) Three lanes
__(4) Two lanes
__(5) More than four lanes
__ (38)

14. Intersection
__(1) Non-Intersection
__(2) Cross-type
__(3) Skewed Cross
__(4) Tee Type
__(5) Wye Type
__(6) Multi-Leg
__ (39)

CODE FOR INTERSECTION ACCIDENTS ONLY.

15. Channelization
__(1) Adequate - present
__(2) Inadequate - present
__(3) Needed - not present
__ (40)

16. Turning Radii
__(1) Adequate
__(2) Inadequate
__ (41)

17. General Design
__(1) Adequate
__(2) Inadequate
__ (42)

18. Signing
__(1) Adequate - present
__(2) Inadequate - present
__(3) Needed - not present
__ (43)

19. Markings
__(1) Adequate - present
__(2) Inadequate - present
__(3) Needed - not present
__ (44)

ESD1 In-Depth Case No. D-_____ On-Site No. S-____

ENVIRONMENT SUMMARY

Identification:

Accident occurred on ______________________________
route or street

(at its intersection with ____________________)

(________ ________ from ____________________)
distance direction

(in) (________ ________ from ________________, _____
distance direction nearest city/town

Township, Indiana; ________________, ______________
configuration marg. dev.

area; on __________, _____ ____, 197__, at ___:___ AM/PM
day of week month date

involving ____
number and type of traffic units

in a __________________ collision. Accident severity
type

was PD/PI-____/F.

Ambience:

______________, ____% ______________ cloud cover,
day, night, etc.

visibility __________, (no precipitation/__________
descriptor

________ (falling), temperature ____°F., relative humidity
type

____%, ____ mph __________ wind gusting to ____ mph. Road

surface was ____________________________, shoulders were

______________________________.

Roadway:

__________________ - ________, ______' wide, ____ lanes,
name of road type

__________ median, ______________ surface in _____________

condition, estimated coefficient of friction 0.____,

(______' ________ shoulders in ______________ condition/

________" ___________ curbs in ____________ condition),

(straight/______' curve __________ going _________),
radius rt. or lt. direction

______" crown/superelevation, (level/______% grade positive

to _________.
direction

__________________ - ________, ______ wide, ____ lanes,
name of road type

__________ median, ______________ surface in _____________

condition, estimated coefficient of friction 0.____,

(______' ________ shoulders in ______________ condition/

________" ___________ curbs in _____________ condition),

(straight/______' curve __________ going _________),
radius rt. or lt. direction

______" crown/superelevation, (level/______% grade positive

to _________.
direction

Traffic Controls:

______________________ - posted/statutory ______ mph
name of road

speed limit, (lines, words or symbols on pavement) ______

____

____

(sign data, legend & position from POI) ________________

____

____

(signal data) None ☐ Number signal faces applicable _____,

visibility _________, condition ___________, green phase

_____ sec., amber _____ sec., red _____ sec., all-red _____

sec., advance or delayed (describe) ____________________

____

____

(flashing lights): None ☐ Red for ___/___ traffic
dir.

Amber for ___/___ traffic
dir.

(protective devices: describe guard rails, abutments,

delineator posts, etc.) ______________________________

____

____

Traffic Controls:

_________________ - posted/statutory _____ mph
name of road

speed limit, (lines, words or symbols on pavement)_____

____

____

(sign data, legend & position from POI)_______________

____

____

(signal data) None ☐ Number signal faces applicable _____,

visibility ________, condition __________, green phase

_____ sec., amber _____ sec., red _____ sec., all-red _____

sec., advance or delayed (describe)__________________

____

____

(flashing lights): None ☐ Red for ____/____ traffic
dir.

Amber for ____/____ traffic
dir.

(protective devices: describe guard rails, abutments,

delineator posts, etc.)____________________________

____

____

Conclusions:

Describe environmental factors felt to have been causally relevant.

Factor	Description
____________	______________________________
	______________________________
____________	______________________________
	______________________________
____________	______________________________
	______________________________
____________	______________________________
	______________________________

Describe observations which might indicate factors pertaining to vehicle or human factors disciplines.

____

____

____

____

____

Recommendations: ______________________________

____

____

____

____

Observations peculiar to this accident not elsewhere recorded:

____

____

____

____

On-Site to In-Depth Transmittal

On-site case S- ☐☐☐☐ In-depth case ID- ☐☐☐☐

Date ☐☐▩☐☐▩☐☐ Time ☐☐☐☐ Hours

Location ______

Investigators ______ and ______

UNIT 1

Year 19 ☐☐ Make ______ Model ______

Color ______ License # ______

Towed to ______ by ______

Driver ______ Age ☐☐☐

Address ______ (number) (street) (town)

Phone ☐☐☐▩☐☐☐☐ (residence); ☐☐☐▩☐☐☐☐ (work)

Time(s) and place(s) to call: ______ (days)

______ (times) and ______ (places)

UNIT 2

Year 19 ☐☐ Make ______ Model ______

Color ______ License # ______

Towed to ______ by ______

Driver ______ Age ☐☐☐

Address ______ (number) (street) (town)

Phone ☐☐☐▩☐☐☐☐ (residence); ☐☐☐▩☐☐☐☐ (work)

Time(s) and place(s) to call: ______ (days)

______ (times) and ______ (places)

Potential in-depth	Driver # 1	Driver # 2
(1) Excellent		
(2) Good		
(3) Fair		
(4) Poor		

Inducements	Driver # 1	Driver # 2
None		
Tow Bills		
Estimate		
Money	$	$
Other (specify)		

Comments: ______

______

Witnesses: ______ name address phone

______ name address phone

Use additional sheet if more than two vehicles involved.

IRPS notified by ☐ BPD ☐ MCSD ☐ ISP ☐ Other Time ☐☐☐☐

IRPS notified by means ☐ Phone ☐ Radio ☐ Monitor

	ARRIVED	DEPARTED: Hr/W		IDENTIFY AGENCY (e.g., BPD, ISP, ..)
IRPS				
Primary Agency				
Secondary Agency				
Ambulance				
First Wrecker				
Second Wrecker				

Were there any near misses or secondary collisions?

If yes, explain: ______________________________

____

____

Was the traffic impeded by the accident vehicle(s), the investigation, or removal operations?

If yes, explain: ______________________________

____

____

DIAGRAM THE ACCIDENT SITUATION

indicate north

APPENDIX G: MAJOR ON-SITE DATA COLLECTION FORMS

On-Site Human Factors Form

Phase and Array Number 4 1 7 (1 2 3)

Number Of: Traffic Units per Accident __ __ (4 5)

On-site, In-depth Flag __ (6)

On-Site Case Number __ __ __ __ (7 8 9 10)

Traffic Unit Number __ __ (11 12)

Card Number 0 1 (13 14)

Date of Collision ______

Vehicle Number ____ Driver No. ____

Driver's Name ______

Address ______

______

Phone Number ______

Vehicle Make and Model ______

______

Interviewer ______

DOS ONLY:
Date Received ______

DRIVER CHARACTERISTICS

1. Sex

__ (1) Male
__ (2) Female

__ (15)

2. Date of Birth __/__/__
mo dy yr

__ __ (16 17)

__ __ (18 19)

__ __ (20 21)

3. Age ______ __ __ (22 23)

4. How is your general health?

__ (1) Excellent
__ (2) Good
__ (3) Fair
__ (4) Poor

__ (24)

5. Do you have any physical disabilities or impairments?

__ (1) No
__ Yes (specify: ______

______

______)

If yes, do you feel that they (it) interfere(s) with your ability to drive?

__ (2) Interfere(s)
__ (3) No Do(es) not interfer

__ (25)

6. Do you wear glasses or contact lenses?

__ (1) Yes, wearing at the time of the accident.
__ (2) Yes, but not wearing at time of accident.
__ (3) No

__ (26)

7. Is your license subject to any restrictions such as requiring corrective lenses, right-hand outside mirror, etc.?

__ (1) Yes (specify: ______

______

______)

__ (2) No

__ (27)

8. Do you smoke?

__ (1) Yes, and smoking at time of accident.
__ (2) Yes, but not smoking at time of accident.
__ (3) No

__ (28)

DRIVER EXPERIENCE

9. How long have you been driving?

______ years

(______ months)

__ __ __ (29 30 31)

On-Site Human Factors Form

10. How many miles do you think that you have driven in the last 12-month period (total yearly mileage)?

______________ miles

(______________ miles/100) __ __ __ __
32 33 34 35

VEHICLE FAMILIARITY

11. Is the accident vehicle your primary mode of transportation?

__ (1) Yes
__ No

If not, what type of vehicle do you usually drive? (check type most frequently driven)

__ (2) Full size (Buick Electra, Ford Galaxie, etc.)
__ (3) Intermediate (Chevelle, Charger, etc.)
__ (4) Compact (Dodge Dart, Gremln, etc.)
__ (5) Subcompact (Vega, VW, etc.)
__ (6) Sports Car (MG, Corvette, etc.)
__ (7) Light truck (Pickup, Van)
__ (8) Motorcycle
__ (9) Other (specify: ______________

______________) __ __
36 37

12. How long have you driven the accident vehicle?

______________ years

(______________ months) __ __ __
38 39 40

13. How many miles do you think that you have driven it in the last 12-month period?

______________ miles

(______________ miles/100) __ __ __ __
41 42 43 44

ROADWAY FAMILIARITY

14. How often do you drive this particular roadway?

__ (1) Daily
__ (2) Twice weekly
__ (3) Once weekly
__ (4) Twice monthly
__ (5) Once monthly
__ (6) Very infrequently
__ (7) First time on roadway

__
45

15. What is the speed limit for this roadway?

______________ mph __ __
46 47

RESTRAINT USAGE

16. Were you wearing a seat belt?

__ (1) Yes
__ No

If not, why not? (check primary reason)

__ (2) Not equipped or available
__ (3) Inconvenient to use
__ (4) Uncomfortable
__ (5) Forgot, but usually use
__ (6) Forgot, not in the habit
__ (7) Use only on long trips
__ (8) Unnecessary, they don't really work anyway
__ (9) Other (specify: ______________

____

______________) __ __
48 49

17. Were you wearing a shoulder harness?

__ (1) Yes
__ No

If not, why not? (check primary reason)

__ (2) Not equipped or available
__ (3) Inconvenient to use
__ (4) Uncomfortable
__ (5) Forgot, but usually use
__ (6) Forgot, not in the habit
__ (7) Used only on long trips
__ (8) Unnecessary, they don't really work anyway
__ (9) Other (specify: ______________

____

______________) __ __
50 51

On-Site Human Factors Form

DRIVER DESCRIPTION OF ACCIDENT

Tape record driver's description of accident -- be certain to cover the areas indicated by the following cues!

Trip origin

Trip destination

Travel direction

Travel lane

Travel speed

Traffic conditions

First awareness of danger

Defensive or evasive behavior assumptions

Preventive, defensive, or evasive action

Immediate pre-crash action

Vehicle response -- mechanical defects or contributing defects

Turn signals, brake lights, headlights, or horn

Loss of vehicle control

Braking delays

Braking technique

Environmental confusion due to roadway design, control devices, etc.

Distractions

View obstruction

Impact speed

Immediate post-crash action

INTERVIEWER ASSESSMENT AND EVALUATION

Did driver seem to be having any of the following difficulties? (check all that apply!)

18. __ Speech impediment __ 52

19. __ Hearing impediment __ 53

20. __ Vision impediment __ 54

21. __ Lack of coordination __ 55

22. __ Inalertness __ 56

23. __ Mental disorientation __ 57

24. __ Other difficulty (specify_____

_____

_____ __ 58

Comment on the significance of any of the above factors:

_____

_____

_____

_____

25. Was there any indication that the driver had consumed any alcoholic beverages?

__ (1) Yes (explain: _____

_____

_____)

__ (2) No __ 59

26. Was there any indication that the driver had taken any drugs or medication?

__ (1) Yes (explain: _____

_____

_____)

__ (2) No __ 60

27. Was there any indication that the driver had been emotionally upset or anxious prior to the accident?

__ (1) Yes (explain: _____

_____

_____)

__ (2) No __ 61

On-Site Human Factors Form

28. Was there any indication that any activity or occurrence inside or outside the vehicle diverted the driver's attention from the driving task?

__ (1) Yes (explain: ______________

____

______________)

__ (2) No

62

29. Was there any evidence that the driver's mind had been preoccupied or wandering?

__ (1) Yes (explain: ______________

____

______________)

__ (2) No

63

30. Was there any indication of driver panic when danger was perceived?

__ (1) Yes (explain: ______________

____

______________)

__ (2) No

64

DRIVER COOPERATION

31. Respondent's attitude toward interviewer.

__ (1) Hostile

__ (2) Suspicious, guarded

__ (3) Casual, impersonal

__ (4) Friendly, cooperative

65

32. In-depth cooperation:

__ (1) Yes, and later cooperation seemed highly likely

__ (2) Yes, but driver reluctant to cooperate

__ (3) No, driver refused for the following reasons:

____

____

____

__ (4) No attempt was made for the following reason:

____

____

____

66

33. Were any inducements useful or necessary in securing cooperation?

__ (1) Yes (explain: ______________

____

______________)

__ (2) No

67

Record times and places when and where driver can likely be reached:

	Place		Time	
(1)	______________	Fr.	____ : ____	AM PM
	______________	TO	____ : ____	AM PM
(2)	______________	Fr.	____ : ____	AM PM
	______________	TO	____ : ____	AM PM
(3)	______________	Fr.	____ : ____	AM PM
	______________	TO	____ : ____	AM PM

On-Site Human Factors Form

ACCIDENT DESCRIPTION

Driver #__________was going N-E-W-S on______________________________________in the

________________traffic lane at a driver estimated speed of______________mph. (Complete driver's description of accident to include all pertinent observations, assumptions, and decisions made, evasive actions taken, and other relevant information. Include driver quotations to assist in narrative where practical).

In-Depth Human Factors Form
Occupant Information

Fill in the chart using the appropriate codes from below.
(Enter any additional information on back of page)

OCC. No.	SEAT POSITION	RE-STRAINTS USED	RE-STRAINTS AVAILABLE	AGE	SEX	AIS	HEIGHT	WEIGHT	AREAS OF OCCUPANT CONTACT
1									
2									
3									
4									
5									
6									
7									
8									
9									

SEX
1=Male
2=Female

Seated Position
01=Left front
02=Center front
03=Right front
04=Left rear
05=Center rear
06=Right rear
07=Left third seat
08=Center third seat
09=Right third seat
10=Bed of truck
11=Inside pickup camper
12=Other
13=Unknown

RESTRAINTS USED AND AVAILABLE
1=None
2=Lap belt only
3=Shoulder belt only
4=Lap and Shoulder belt
5=Unknown

AIS
0=No injury
1=Minor
2=Moderate
3=Severe injuries (not life-threatening)

AIS cont.
4=Severe injuries (life-threatening, survival probable)
5=Critical injuries
6=Fatality (one fatal lesion)
7-8-9: Review AMA codes
10=Unknown

CODES FOR AREAS OF OCCUPANT CONTACT

00=Unknown
01=Air conditioning or ventilation outlets
02=Glove compartment area
03=Hardware items (ashtray, instruments, knobs, etc.)
04=Heater or AC ducts
05=Instrument panel
06=Mirrors
07=Parking brake
08=Radio
09=Steering assembly
10=Sunvisors & fittings, and/or top molding (header)
11=Transmission selector lever
12=Windshield
13=Armrests
14=A-pillar
15=B-pillar

AREAS OF CONTACT CONT.

16=C-pillar
17=D-pillar
18=Courtesy lights
19=Hardware (sides)
20=Surface of side interiors
21=Window frames
22=Window glass
23=Backlight (rear window)
24=Coat hooks
25=Roof or convertible top
26=Roof side rails
27=Console
28=Foot controls
29=Back of seats
30=Head restraints
31=Interior loose object
32=Other occupants
33=Restraint system hardware
34=Restraint system webbing
35=Hood
36=Objects exterior to car
37=Outside surface of car
38=Other
39=Backlight header
40=Other occupants
41=Flying glass
42=Tapedecks
43=Road surface
44=Eye glasses
45=Floors
50=No contact

Alcohol Question Supplement

1. Was there any indication that the driver had consumed any alcoholic beverages?

   _____ Yes, and this was confirmed either by odor of alcohol on breath, admission of driver, or testimony of passenger. Presence of open beer cans, etc., might also provide adequate evidence under certain circumstances.

   _____ NO, no evidence of alcohol use, or evidence of use is inadequate and does not meet requirements stated above.

2. IF YES TO ABOVE, was there indication that the driver was intoxicated to the point of being "drunk?"

   _____ Yes, it is definite or probable that the driver was "drunk." Driver showed obvious signs of impairment, such as:

   - difficulty in standing or walking
   - irregularity of sway when standing still
   - other indication of coordination difficulty
   - thick tongue and difficulty speaking
   - lack of coherence; difficulty in "tracking" conversation
   - eyes bloodshot or light sensitive
   - extremes of behavior -- excessively passive or belligerent
   - BAC, if known, is over .20% blood alcohol

   _____ Yes, but evidence is fragmentary, so that we are limited to concluding only that it is possible that the driver was "drunk." For example, driver might have been overly passive or overly belligerent, but have had no trouble with coordination, speech, etc.

   _____ NO, there is no evidence of drunkeness. The driver had definitely consumed some alcohol, and may even have been feeling somewhat exhilarated or "high," but has no symptoms of drunkeness such as those listed above.

3. IF YES TO QUESTION #1 at top of page, obtain and enter the following information:

   a. height and weight: __________ lbs. and ________ ft. ________ in.

   b. type and amount of beverage: ______________________________

   c. time of last drink: ______________________________

   d. time of first drink: ______________________________

   e. time of and size of last meal; ______________________________

   f. whereabout and activities for 6 hours preceding crash: _______

   ____

   ____

4. BAC level if known ___.___% (source:_________________________)
BPD, MCSD, CORONER, ETC.

5. If "Yes" to ITEM 2 above, briefly describe the driver's condition and behavior that led you to classify him as being "drunk."

____

RETURN TO ITEM 26.

ES2

On-Site Environmental Form

On-Site case no._______________

I. IDENTIFICATION

A. Accident location____

____

B. Day of week__________________

C. Date________________________

D. Accident was a: ☐ PD ☐ PI ☐ Fatal

II. ATMOSPHERIC CONDITIONS

A. Light (check one only): ☐ Day ☐ Night ☐ Dusk ☐ Dawn

B. Cloud cover (check one only): ☐ Clear ☐ Part ☐ Full

C. Precipitation:

1. Intensity (check one only):
☐ None ☐ Light ☐ Moderate ☐ Heavy

2. Type (check all that apply):
☐ Rain ☐ Sleet ☐ Hail ☐ Snow ☐ Other________________________

D. Temperature: approximately___________ F

E. Wind:

1. Intensity (check all that apply):
☐ Slight ☐ Moderate ☐ Hard ☐ Gusting ☐ Calm

2. Blowing from (check one only):

☐ North
☐ South
☐ East
☐ West

☐ Northeast
☐ Southeast
☐ Southwest
☐ Northwest

☐ Variable
☐ Unknown

G. Visibility (check one only):
☐ Clear ☐ Hazy ☐ Fog ☐ Other

III. TRANSITORY ENVIRONMENT

A. Traffic was (check one only):
☐ Light ☐ Moderate ☐ Heavy ☐ Could not estimate pre-crash flow

B. For this area and time, however, traffic was:
☐ About normal ☐ Abnormal

IRPS-On-Site/Env Form

C. Upon arrival pavement was (check all that apply):

1. ☐ Dry
2. ☐ Damp
3. ☐ Wet
4. ☐ Slushy
5. ☐ Loose snow-pack
6. ☐ Hard snow-pack
7. ☐ Icy
8. ☐ Other (specify)__________
9. ☐ Foreign matter (specify)__________

D. Coefficient of friction estimate (one value only with last digit "0" or "5"):

@ 0.______% g.

IV. ACCIDENT DESCRIPTION

A. Converging trajectories (check all that apply and sequence occurrence):

1. ☐ Head-on................_____
2. ☐ Opposing oblique........_____
3. ☐ Right angle............_____
4. ☐ Acute oblique..........._____
5. ☐ Rear-end..............._____
6. ☐ Ran-off-road..........._____
7. ☐ Overturned-on-road....._____
8. ☐ Other (specify)........_____

B. Additional descriptors (check all of the following which you know to have occurred):

1. ☐ Vehicle(s) rolled over
2. ☐ Fire erupted
3. ☐ Door(s) came open on impact

C. Objects other than traffic units struck (check all that apply):

1. ☐ None
2. ☐ Guard rail
3. ☐ Sign post
4. ☐ Tree
5. ☐ Utility pole
6. ☐ Bridge abutment or rail
7. ☐ Other__________

V. HIGHWAY AND SCENE DATA

A. Check only one which applies:

1. ☐ Non-intersection accident
2. ☐ Intersection accident

B. General information

1. Marginal Development (check all that apply and indicate primary one, "P"):

☐ Residential....._____
☐ Commercial......_____
☐ Industrial......_____
☐ Agricultural...._____
☐ Undeveloped....._____
☐ School.........._____
☐ Other__________...._____

2. Signs (regulatory or warning within 300' of POI) ☐ None

Fillin the blank with the type of sign and check box only if obstructed:

a. Driver #1: __________ ☐ __________ ☐ __________ ☐
b. Driver #2: __________ ☐ __________ ☐ __________ ☐
c. Driver #3: __________ ☐ __________ ☐ __________ ☐
d. Driver #4: __________ ☐ __________ ☐ __________ ☐
e. Driver #5: __________ ☐ __________ ☐ __________ ☐

3. Lines/symbols/words on pavement:

a. ☐ None
b. Check both information presented and driver to which it applies:

	Driver no. 1	2	3	4	Comment below if faded, obstructed, etc.
1. ☐ Single black and/or white	☐	☐	☐	☐	__________
2. ☐ Double solid yellow	☐	☐	☐	☐	__________
3. ☐ No passing (line)	☐	☐	☐	☐	__________
4. ☐ Edge line	☐	☐	☐	☐	__________
5. ☐ Stop	☐	☐	☐	☐	__________
6. ☐ Lane lines	☐	☐	☐	☐	__________
7. ☐ Crosswalk	☐	☐	☐	☐	__________
8. ☐ Turn arrows	☐	☐	☐	☐	__________
9. ☐ Straight arrows	☐	☐	☐	☐	__________
10. ☐ Other words (identify): __________	☐	☐	☐	☐	__________

4. View obstruction

a. (check one only) ☐ None ☐ Permanent ☐ Temporary
b. If permanent or temporary view obstructions were noted, check boxes to indicate all drivers whose vision was obscured:

1. ☐ D-1
2. ☐ D-2
3. ☐ D-3
4. ☐ D-4
5. ☐ Other (list): __________

c. Parked units

1. ☐ Parked legally ☐ Parked illegally
2. Distance of closest bumper to intersecting street or other landmark: (P-1) __________ feet from __________
(P-2) __________ feet from __________
(P-3) __________ feet from __________

NOTE: fill out only if at intersection

5. Type of intersection

a. 4 Legs
- ☐ Cross
- ☐ Off-set cross
- ☐ Narrowing cross
- ☐ Wye-tee

3 Legs
- ☐ Tee
- ☐ Wye (tangent)
- ☐ Wye (divergent)

- ☐ Other ______________

6. Traffic signals

a. ☐ None
b. ☐ Set cycle
c. ☐ Variable cycle due to pressure pad or detector
d. Visibility/condition (check all that apply):

- ☐ Good
- ☐ Fair
- ☐ Poor
- ☐ Obstructed

e. Flashing light: ☐ Yes ☐ No

1) If yes to flashing light, was it RED? ☐ Yes ☐ No
2) If yes to red (check all that apply):

a) ☐ N-S traffic
b) ☐ E-W traffic

3) If yes to flashing, was it AMBER? ☐ Yes ☐ No
4) If yes to amber: ☐ N-S traffic ☐ E-W traffic

NOTE: fill out only when conditions warrant

7. Highway lighting

a. ☐ None
b. ☐ Mercury-vapor
c. ☐ Sodium-vapor
d. ☐ Fluorescent
e. ☐ Incandescent
f. ☐ Other ______________

g. Effectiveness

- ☐ Good
- ☐ Fair
- ☐ Nil

C. Roadway descriptions

	For unit(s) 1 2 3 4 5 6	For unit(s) 1 2 3 4 5 6	For unit(s) 1 2 3 4 5 6	
Name				Comments
Two-way	☐	☐	☐	
One-way	☐	☐	☐	
Asphalt	☐	☐	☐	If other, identify in margin
Concrete	☐	☐	☐	
Gravel	☐	☐	☐	
Dirt	☐	☐	☐	
Other	☐	☐	☐	
New and sharp	☐	☐	☐	If other, identify in margin
Traveled and worn	☐	☐	☐	
Traffic Polished	☐	☐	☐	
Excessively oily	☐	☐	☐	
In good repair	☐	☐	☐	Check all that apply
Cracked	☐	☐	☐	
Chuckholes	☐	☐	☐	
Other	☐	☐	☐	
Straight	☐	☐	☐	If other, identify in margin
No crown	☐	☐	☐	
Normal crown	☐	☐	☐	
Excessive crown	☐	☐	☐	
Other	☐	☐	☐	
Curved	☐	☐	☐	From one tangent to another
0-30°	☐	☐	☐	
31-60°	☐	☐	☐	
61-90°	☐	☐	☐	
Over 90°	☐	☐	☐	
Reverse camber	☐	☐	☐	If other, identify in margin
No bank	☐	☐	☐	
Excessive bank	☐	☐	☐	
Normal	☐	☐	☐	
Other	☐	☐	☐	
Level	☐	☐	☐	Level is 1 % or less
% pos to:	to	to	to	
Curb and gutter	☐	☐	☐	Identify other and comment if any are cont. hindrances
Shoulder	☐	☐	☐	
Grass and weeds	☐	☐	☐	
Ditch	☐	☐	☐	
Other	☐	☐	☐	
Width				nearest foot
Speed limit	MPH	MPH	MPH	
Posted	☐	☐	☐	
Statutory	☐	☐	☐	

VI. IMPACT DATA

A. Measurements:

1. RP:______________________ ______ft. N-E-W-S of RL

2. RL:______________________________________

3. POI:______________ft. N-E-W-S of RP;______ft. N-E-W-S of RL

4. #2:______________ft. N-E-W-S of RP;______ft. N-E-W-S of RL

B. Pre-impact skidmarks:

Unit #1:	Unit #2:	Unit #3:
☐ None	☐ None	☐ None
LF______ft	LF______ft	LF______ft
RF______ft	RF______ft	RF______ft
LR______ft	LR______ft	LR______ft
RR______ft	RR______ft	RR______ft

C. Post-impact travel: (skid, free-roll, roll-over, vault, etc.)

1. Unit #1______________ ______________ ________ft
   (action) (surface)

   ______________ ______________ ________ft

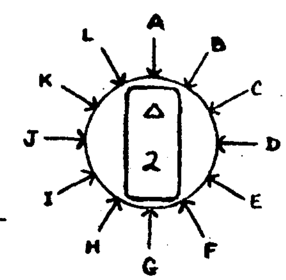
2. Unit #2______________ ______________ ________ft
   ______________ ______________ ________ft

3. Unit #3______________ ______________ ________ft
   ______________ ______________ ________ft

D. Final rest positions:

1. Unit #1	L-R Frt.______	ft.	______of RP;	______	ft.	______of RL
	L-R Rear______	ft.	______of RP;	______	ft.	______of RL
2. Unit #2	L-R Frt.______	ft.	______of RP;	______	ft.	______of RL
	L-R Rear______	ft.	______of RP;	______	ft.	______of RL
3. Unit #3	L-R Frt.______	ft.	______of RP;	______	ft.	______of RL
	L-R Rear______	ft.	______of RP;	______	ft.	______of RL

VII. RECONSTRUCTION DATA



A. Angle of converging trajectories: Code________
   (Use item #2 as struck traffic unit)

B. Identify any unit(s) moved before arrival__________

C. Was the true FRP of the above unit(s) ascertained?

   ☐ Yes ☐ No

ADDITIONAL COMMENTS:

TAC On-Site Vehicle Data Form

LOCATION: ____________________

I. GENERAL INFORMATION

A. Accident on-site case number ____________________

B. Accident in-depth case number ____________________

C. Vehicle number ____________________

II. IDENTIFICATION

A. Vehicle type ____________________

B. Make ____________________

C. Model ____________________

D. Model year 19____

E. Number doors ____________________

F. Body style ____________________

G. Colors ____________________

H. License

1. Number ____________________
2. State ____________________
3. Year ____________________

I. Vehicle identification number ____________________

III. COCKPIT

A. Odometer reading ____________________

B. Inspection

1. Date ____________________
2. Mileage ____________________
3. State ____________________
4. Number ____________________
5. Station No. ____________________

E. If inspected:

☐ Hood was opened

☐ Hood would not open

☐ Not Applicable

Note: An inspection is not "incomplete" merely because the hood would not open, for purposes of C & D above.

C. Vehicle Inspection:

☐ Was completed, as far as damage would allow

☐ Was not completed

D. If not completed as far as damage would allow, was due to:

☐ Lack of time

☐ Lack of permission or cooperation

☐ Other (explain): ____________________

Note: For purposes of this form, LEFT (l) is the driver's left as he sits in the vehicle facing forward. Similarly, RIGHT (r) is the driver's right.

IV. TIRES

1. lF tire pressure ________/psi (if zero, explain: ____________
   ____)

   Tread depth Inner _____/32, Center _____/32, Outer _____/32

   Size, make/model ______________________ Type ____________

2. lR tire pressure ________/psi (if zero, explain: ____________
   ____)

   Tread depth Inner _____/32, Center _____/32, Outer _____/32

   Size, make/model ______________________ Type ____________

3. rR tire pressure ________/psi (if zero, explain: ____________
   ____)

   Tread depth Inner _____/32, Center _____/32, Outer _____/32

   Size, make/model ______________________ Type ____________

4. rF tire pressure ________/psi (if zero, explain: ____________
   ____)

   Tread depth Inner _____/32, Center _____/32, Outer _____/32

   Size, make/model ______________________ Type ____________

	CNC	P	D	AD	Comments
V. BRAKES					
5. Fluid level					
6. Hoses					
7. Pedal reserve and Leak-down . .					
8. Servo: ☐ Yes ☐ No					
VI. STEERING					
9. Linkage					

	CNC	P	D	Al	Comments
10. Play (Record amount:____deg.).					
11. Power assist ☐Yes ☐No					
12. Power steering belt.					
13. Power steering fluid level . .					
14. Power steering leaks					
VII. VISION					
15. Windshield obstruction					
16. Window obstruction (side & rear).					
17. Wipers					
a. at time of accident ☐on ☐off ☐unknown					
b. condition and function . .					
c. park position.					
18. Washers ☐N/E					
a. reservoir.					
b. function					
c. aim.					
19. Mirror (inside) ☐N/E					
20. Mirrors					
a. outside - left ☐N/E . .					
b. outside - right ☐N/E . .					
VIII. SUSPENSION					
21. Shock absorber function					
a. lF					
b. lR					
c. rR					
d. rF					

	CNC	P	D	AD	Comments
IX. LIGHTS					
22. Stop lamp function					
a. left.					
b. right					
23. Turn indicator function					
a. lF.					
b. lR.					
c. rR.					
d. rF.					
24. Rear light lens condition					
a. left.					
b. right					
X. CONTROLS					
25. Shift lever position at time of accident: ☐Known: ________ ☐Unknown					
26. Horn.					
XI. CONTINGENT FACTORS					
Note: Check the following when specified or whenever conditions warrant.					
27. When DARK check LIGHTS:					
a. at time of accident, light switch was: ☐on-high ☐on-low ☐on-beam unknown ☐on "park" ☐switch position unknown					
b. headlamp function					

	CNC	P	D	AD	Comments
(2) left inner or lower - High ☐N/E					
(3) right inner or lower- High ☐N/E					
(4) right outer or upper - High . .					
(5) left outer or upper - Low . . .					
(6) right outer or upper - Low. . .					
c. front parking lights ☐N/E					
(1) come on with headlamps ☐yes ☐no					
(2) function - left					
(3) function - right.					
d. tail light function					
(1) left.					
(2) right . . . . . ☐N/E					
e. sidemarker function ☐N/E					
(1) lF.					
(2) lR.					
(3) rR.					
(4) rF.					
28. IF reversing, back-up lights ☐N/E					
29. IF was stopped along road, 4-way Flasher ☐N/E					
a. ☐in-use ☐not in use ☐use unknown					
b. function					
30. Defroster (if in use or if use would have been desirable)					
a. ☐in-use ☐not in use ☐use unknown					

	CNC	P	D	AD	Comments
b. control position: ______	▒	▒	▒	▒	
c. function.					
31. If relevant due to vision obstruction, etc., window roll-down mechanism	▒	▒	▒	▒	
a. lF.					
b. rF.					

XII. LOADS

30. Luggage and other interior loads: (other than passengers)

☐yes Estimated weight________pounds.

☐no

☐unknown

31. Trunk or cargo area:

☐yes Estimated weight________pounds.

☐no

☐unknown

32. Rooftop:

☐yes Estimated weight_________pounds.

☐no

☐unknown

XIII. BRIEF DESCRIPTION OF VEHICLE DAMAGE

____

____

____

____

____

XIV. ADDITIONAL COMMENTS

Please comment on other vehicle deficiencies observed, unusual modifications, physical evidence, etc.

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