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Analyses of U.S. Army Accident Data

Clifford P. Hahn
American institutes for Research
Prepared under HumRRO Subcontract

HUMAN RESOURCES RESEARCH ORGANIZATION
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16. Abstract

Existing U.S. Army Accident Record data were analyzed, seeking relationships that would lead to recommendations for future routine analyses of such data which might help reduce the number and severity of accidents. Numerous computer analysis printouts were submitted to the sponsoring agency. The report describes project activities, distributional results, regression analysis results, and results from a method for comparing relative accident involvement rates. Characteristics of the existing record system and the types of analyses that can be conducted are also discussed. The general conclusion is that the present system seems adequate for inventorying accidents but not (a) to identify human factors associated with on-and-off duty accident experiences; (b) to identify material and equipment design and use characteristics associated with on-duty accidents; or (c) to determine man/vehicle/equipment interactions and their influences on accident and injury incidents.

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FOREWORD

The overall objective of HumRRO Exploratory Research 72, Accident Data Analysis, was to analyze existing U.S. Army Accident Record data in search of relationships that could lead to recommendations for future analyses which might be helpful in reducing the number and severity of accidents. ER-72 was supervised by Dr. Robert G. Smith, Jr., then Assistant Director for Operations. The study was conducted while HumRRO was a part of The George Washington University.

The work reported here was performed by the American Institutes for Research (AIR), Washington, D.C. office, under HumRRO subcontract No. 2-006 (ES-72). The principal investigator was Clifford P. Hahn, author of this report. The HumRRO project monitor was Dr. Smith. Personnel of the Safety Division, Office of the Deputy Chief of Staff for Personnel, who participated in discussion sessions and other activities which guided the research, included Mr. T.H. Wilkensen, Dr. Francis S. McGlade, and Mr. David Billings. The major part of the computer analyses was accomplished under the direction of Dr. Richard T. Johnson, initially on the AIR staff and later from Stanford University, and Dr. Glenn E. Roudabush of AIR and Westinghouse Learning Corporation Staff. Special appreciation is due Mrs. Sue Hull of Stanford University for her part in completing the third set of analyses. A major share of project activities was carried out under the direction of Mrs. Dorothy Krug, who served as Project Director from the initiation of the project through the second set of analyses, including the work on the indirect measures of exposure. Dr. Dorothy S. Edwards also helped guide the initial structuring of the analyses.

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President
Human Resources Research Organization

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MILITARY PROBLEM

Each year the United States Army incurs tremendous losses in terms of personnel fatalities, injuries, and property damage as a result of automotive, aircraft, and other accidents. These losses are well documented by the master U.S. Army Accident Record file maintained by the U.S. Army Data Support Command (USADATCOM) for the U.S. Army Safety Division in the Office of the Deputy Chief of Staff for Personnel.

To maximize the effectiveness of programs to counteract the magnitude of these losses and to reduce the frequency of accident occurrence, programs should be based upon as much factual data as possible. It seemed appropriate, therefore, to conduct a systematic review of these basic data somewhat apart from the more usual actuarial or accounting framework, looking rather for data bearing on possible causal relationships which might provide at least a partial basis for remedial action programs.

RESEARCH OBJECTIVES

The major research objectives were (a) the identification of a set of human factors associated with both on-duty and off-duty accident experiences; (b) the identification of material and equipment design and use characteristics associated with on-duty accident experience; (c) the determination of man/vehicle/equipment/environment interactions, and their influences on accident, fatality, and injury incidents.

RESEARCH METHODS

The basic data source for all analyses made was the master Army Accident Record tape maintained by DATCOM for the Army Safety Division. The data included all recorded automotive, aircraft, and other accidents whose dates of occurrence fell within Fiscal Year 1967. These data were subjected to three sets of general analyses, as well as a special analysis utilizing an indirect means for measuring exposure to accidents.

The first set of analyses consisted essentially of unselected distributions of all variables in terms of frequencies, percentages, and cumulative frequencies and percentages. Based on a review of these analyses, changes were made in the definition and coding categories for certain critical variables, and a decision was made to treat aircraft, automotive, and other accidents separately. Eleven basic criterion indices were selected for use in the second set of analyses. Frequencies, percentages, and cumulative frequencies were calculated for 28 selected variables in terms of the 11 indices. Following a review of these analyses, personnel and ownership categories were redefined before the third set of analyses, which separated Vietnam experience from all others.

In addition to the three sets of distributional analyses, regression analyses of selected critical variables and criterion indices were carried out.

A special set of analyses was run in an attempt to utilize an indication of exposure to accidents as an evaluative control variable. An indirect method was utilized for determining the exposure index, based on a comparison of accident experience of culpable and non-culpable personnel.

CONCLUSIONS AND IMPLICATIONS

Distributional analyses of the number of accidents experienced indicated that the Army motor vehicle use rate is a useful although imperfect index of Army motor vehicle accidents. It also appears that military man-days are an excellent index of the number of private motor vehicle accidents as well as a fairly good index of the number of non-motor vehicle/non-aircraft accidents. Regression analyses of the number of accidents happening showed that much of the variance was accounted for by a few generalized exposure variables, thus leaving little to be potentially accounted for by specific variables that could form the focus for remedial action programs.

Conclusions from analyses of data concerning the involvement of different types of personnel are much the same. Various classes of personnel seem to be involved in accidents roughly in proportion to the numbers assigned to an organizational unit. A usage index also was highly correlated with measures of accidents. With some exceptions in the case of non-motor vehicle/non-aircraft accidents, the greatest part of the variance in accident occurrence was accounted for by rather over-generalized personnel and usage factors.

Interorganizational comparisons indicated apparent over-involvement of some units in accidents experienced. However, because of the nature of the basic data they shed little light on possible reasons for such over-involvement. The regression data were somewhat disheartening because of the large proportion of the variance that could be accounted for through the use of rather simplified and over-generalized exposure indices.

The comparative analyses utilizing "innocent" and "culpable" groups did focus attention on certain groups within a single variable. Again, because of the nature of the basic data this information in itself contributed little toward understanding why the situation existed. Thus, even if one accepts the fundamental validity of the essentially untested assumptions underlying the method used for determining exposure, it identifies relatively specific areas for further study but does not directly provide the means for deeper probing.

In large part, the study was unsuccessful in attaining the hoped-for objectives of identifying critical human factors, design factors, or man/machine/environmental factors that could be effectively manipulated in remedial programs to reduce the Army's losses due to accidents. Perhaps this was too much to expect, since data collected through a record system developed for inventory purposes were used to address causality factors within a controlled analytic framework. It was not surprising that critical data gaps existed since this often happens when one attempts to utilize data collected for one purpose for a different, even though related, purpose. Certain system-related characteristics further limited the use of the available data for making causal analyses.

Implications for research arising from this study were that further comprehensive Army-wide analyses of these data would probably not be effective in identifying human factors or material and design factors related to accident experience. The current data were recorded at too general a level and data other than that presently included in the system are necessary. Intensive studies with a more limited scope are needed. In addition, the data requirements for a system designed for causal analyses should be determined so that an assessment could be made of the adequacy of the present system and the need for a new system.

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Analyses of U.S. Army Accident Data

Part I

INTRODUCTION

PURPOSE

The primary purpose of the project described in this report was to carry out a set of analyses in an attempt to (a) identify human factors associated with on-and-off duty accident experience, (b) identify material and equipment design and use characteristics associated with on-duty accidents, and (c) determine man/vehicle/equipment interactions and their influences on accident and injury incidents.

The activities carried out to attain this objective were guided by suggestions of the American Institutes for Research (AIR) project staff and personnel from the U.S. Army Safety Division, Office of the Deputy Chief of Staff for Personnel, with concurrence from the project monitor through his participation in discussions and decision making conferences. Some modification of the original objective in terms of the amount of detail was necessary in view of the type of data made available by the U.S. Army for analysis.

PROJECT ACTIVITIES

Basic Data Source

Initial activities consisted of meetings between the AIR project staff, the Human Resources Research Organization (HumRRO) monitor, and personnel from the Army Safety Division. Early contacts were also made with personnel from the U.S. Army Data Support Command (USADATCOM) who were responsible for the processing of the Army Accident Record tape. Delivery of the basic data from DATCOM to AIR was delayed somewhat in order to allow DATCOM to complete a record correction operation that was under way and to allow for the addition of data for the first half of FY 1968 to the existing data of FY 1967. Upon receipt of the basic accident record tape, simple frequency distributions were attempted but not completed because of deficiencies in the physical quality of the tape supplied. This caused further delay while tape records were regenerated for use in making the analyses.

First Set of Analyses

An initial computer analysis was made that resulted in a printout in terms of frequencies, percentages, and cumulative frequencies and percentages for the following:

(1) By separate commands and total frequencies and percentages of the number of accidents; number of lost-time injuries; number of first-aid only and other non-lost-time injuries; and number of property damage accidents.

(2) By separate commands and total frequencies, percentages, and cumulative frequencies and percentages for the following variables: hour of day; day of week; day of month; month; classification of accident; age; sex; grade; classification and status of personnel; hours on duty; training status; activity at time of accident; extent of disability; number of days lost; nature of injury; location of injury; cause of injury; ownership; amount of property damage; corrective action taken; weather; supervision; agency of

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the accident; type of motor collision; unsafe condition; unsafe act; and unsafe personal factor.

This initial printout, which included all readable records for both FY 1967 and the first half of FY 1968, was reviewed and discussed with the HumRRO monitor and personnel from the Army Safety Division. Two major points resulting from this review materially affected future analyses:

First, it was decided to prepare separate analyses for motor vehicle accidents, aircraft accidents, and all other accidents.

Second, it was decided to use only data that occurred during FY 1967. The determination of date was to be based upon date of occurrence rather than upon date of reporting of the accident to the Department of the Army as had been the custom. It was found that the reporting lag varied from command to command, depending upon location and type of activities in which the command was engaged. Any factors associated by calendar periodicity would therefore be obscured by these reporting lag discrepancies.

The decision to analyze data on the basis of date of occurrence necessitated another screening of the basic data tape and regeneration of a revised basic tape record. Records from early FY 1967, which represented FY 1966 date of occurrence, were dropped and records from early FY 1968, which represented FY 1967 date of occurrence, were included. All other FY 1968 data were dropped.

The review of the initial run also brought to light the problem of multiple records per accident. There are a number of variables that can assume only one value for each accident. These include all variables in Section A of Form 285 (command, time and date of accident, etc.) as well as factors such as weather and agency of the accident; data for these variables are duplicated from Card Number 1 and entered into all additional cards. There are other variables, however, that can have one or more values per accident. These include ownership of damaged property, amount of property damage shown separately for each owner, unsafe conditions, unsafe acts, unsafe personal factors, and others. In cases where these variables have only one value and there is no new information to enter on additional cards being used for additional personnel data, these variables are coded Not Applicable.

In order to avoid later misinterpretations, the following definitions were established for future analytic activities:

(1) Number of accidents: This is equal to the number of Cards Number 1.
(2) Number of personnel: This is equal to the number of records in which sex was designated.
(3) Number of records: This is equal to total number of all readable records. In any analysis involving all records, careful attention was to be given to the treatment and interpretation of the Not Applicable category.

As might be expected, it was clear from the initial printout of frequency distributions that changing the format of the internal coding categories of several variables would expedite the interpretation of future analyses. Format changes were made before additional analyses were begun.

Second Set of Analyses

After consultation with the HumRRO monitor and personnel from the Army Safety Division, it was decided that the next set of analyses would deal with the following 11 basic indices:

(1) Number of accidents, number of records, or number of persons, as appropriate, according to the variables involved.
(2) Number of civilian personnel involved in accidents.
(3) Number of military personnel involved in accidents.
(4) Total number of personnel involved in accidents.

(5) Number of civilian lost-time injuries.
(6) Number of military lost-time injuries.
(7) Total number of lost-time injuries.
(8) Number of civilian fatalities.
(9) Number of military fatalities.
(10) Total number of fatalities.
(11) Amount of property damage.

The three classes of accidents—motor vehicle, aircraft, and all others—were dealt with separately. Separate summary printouts were prepared for worldwide data including Vietnam, and for Vietnam data only.

Printouts were prepared showing frequencies, percentages, and cumulative frequencies and percentages for each of the above indices and for each of the 28 variables involved in the first set of analyses.

An informal, working-paper, analytical summary of the second set of analyses was prepared by the AIR project staff. This summary was explained and discussed at a meeting of personnel from HumRRO, the Army Safety Division, and the AIR staff. Printouts of the analyses were then made available to the HumRRO monitor and the Army Safety Division for detailed review prior to their requests for additional analyses.

Third Set of Analyses

After review of the second set of analyses, the Army Safety Division requested the following additional computer analyses utilizing some redefined reporting categories:

(1) Army Motor Vehicle Accidents Worldwide Excluding Vietnam Data.
For this analysis, Army Motor Vehicle was defined to mean Army Motor Vehicle, Army operated; Army Motor Vehicle, contractor operated; and both Army Motor Vehicle and non-Army Motor Vehicle.

(2) Army Motor Vehicle Accidents for Vietnam Only.
The same definition of Army Motor Vehicle as indicated above was used.

(3) Private Motor Vehicle Accidents Worldwide Excluding Vietnam Data.
For this analysis, Private Motor Vehicle was defined to mean non-Army Motor Vehicle (private, commercial, etc.).

(4) Private Motor Vehicle Accidents for Vietnam Only.
The same definition of Private Motor Vehicle as indicated above was used.

(5) Other Accidents Worldwide Excluding Vietnam Data.
For this analysis, the definition of Other Accidents included those accidents that involved neither motor vehicles nor aircrafts.

(6) Other Accidents for Vietnam Only.
The same definition of Other Accidents as indicated above was used.

Some changes were also made in the definitions of the various types of personnel involved and ownership status of property damage for purposes of this third set of analyses:

(1) Military Personnel included all Active Army personnel, all Army reserves on active duty for training, and all Army National Guard Reserve Enlisted Program personnel.

(2) Civilian Personnel included all on-duty Army Civil Service employees and those on permanent change of station, travel, and temporary duty.

(3) Other Army Personnel included all Army ROTC (summer camp training personnel), Army Reserve (reserve duty training), Army National Guard (summer camp training personnel), all on-duty Army contractor employees, all on-duty nonappropriated fund activity employees, and all direct- and indirect-hire foreign national employees.

Personnel not included in the third set of analyses were all personnel from non-Army services, all off-duty Civil Service employees, all off-duty Army contractor employees, all dependents of U.S. personnel either military or civilian, and all visitors, prisoners of war, foreign military personnel, and civilian internees. Because of these changes in definitions, frequency data were not directly comparable from one set of analyses to another.

For purposes of the third set of analyses these additional variables were redefined as follows:

(1) Ownership—to mean Army, Army contractor, and Army nonappropriated fund activity only.

(2) Property damage—to include amounts only for the above indicated ownership status of property.

Computer printouts of analyses were prepared for each of the six analyses specified earlier. In addition, a separate printout was prepared showing amount of property damage for each of the 28 previously selected variables for each of the six specified analyses. Fully indexed and labeled copies of these printouts were submitted for use by HumRRO and the Army Safety Division. A comprehensive description of the tables and coding categories was included with these printouts. These data are not reproduced in this report.

Special Exposure Analyses

One difficult aspect of interpreting accident experience data is the need for a baseline or reference framework against which actual accident experience can be compared. An effort is usually made to utilize an exposure rate base of some type in order to equate the opportunities of different groups for having an accident. Standard rate bases are usually in terms of some type of personnel-hour data or equipment or facility usage rate. For purposes of this project, the Army Safety Division provided man-day data as well as Army motor vehicle mileage data for FY 1967 for major Army commands. These data are normally used as a base to calculate frequency and severity rates. In this project, however, the staff utilized these data in special regression analyses to determine how much of the variance of the different accident categories could be accounted for with them. These regression analyses were carried out for command data only because they accounted for such a large portion of the total variance and thus served as a good example of the type of results and limitations of this type of analytic approach.

Another method for dealing with the general exposure problem was described by John D. Thorpe in his article, "Calculating Relative Involvement Rates in Accidents Without Determining Exposure," in the March 1967 edition of *Research Review*. The basic hypothesis is that the probability of a particular man/machine/environment combination being involved in an accident as a nonresponsible or innocent factor is about the same as the probability of that particular man/machine/environment occurring. With the acceptance of this assumption, an indirect measure of exposure can be derived, if the innocent involvement portion of total involvement in accident experience can be identified. The basic assumption, of course, is fallacious to the extent that responsibility is not usually a 100%/0% situation. However, in large enough samples of data, such as were available in this project, errors should not greatly vitiate the hypothesized relationship.

Since it was possible to identify an "Innocent" group and a "Culpable" group, this type analysis was conducted for the variables of age, sex, grade, classification and status of personnel, hours on duty, training status, and activity at time of accident. For purposes of these analyses, Innocent was defined as any person involved in an accident for which neither an unsafe act nor an unsafe personal factor was recorded. Culpable was defined as any person involved in an accident who did not meet the Innocent criterion.

Special distributions of innocent and culpable groups were prepared for the variables indicated in this paragraph.

Computer Facilities

All of the computing through the first two sets of analyses was carried out by the AIR computing center located in Palo Alto, California, on an IBM 360 system, with programs devised by the staff. During the course of the project this computing center was discontinued, causing further delays in completing the desired computer analyses. The third set of analyses was carried out by the Institute of Political Studies, Stanford University, utilizing its statistical package for the social sciences, version of 18 November 1968. The regression analyses were done on the IBM 1130 system at the AIR Washington facilities.

Results of third set and special exposure analyses appear in Part II of this report.

Part II

DISCUSSION OF RESULTS

Most of the detailed data analyses were reported in the form of computer printouts. Copies of these printouts, together with a detailed description of their contents, were submitted separately to the sponsoring agency. These detailed analyses are not repeated in this report. Some summary data have been excerpted and presented here to illustrate the kinds of questions that can be addressed with various types of data analysis approaches.

The results discussed herein involve inter-unit comparisons in which both frequency distributional data and regression data are utilized. They also involve a review of distributional data for many of the 28 basic variables with special Innocent/Culpable comparisons for seven variables.

ACCIDENT EXPERIENCE BY ORGANIZATIONAL UNIT

One area of concern in accident analysis is how organizational units compare in terms of actual accident occurrence within a stipulated time period. Since responsibility for the operation of these units includes responsibility for the safety record engendered, unit leaders also have eventual responsibility for remedial programs to reduce the losses through personal injury and property damage. Equitable intergroup comparisons in terms of actual loss experience should provide to unit leaders and their superiors guidance toward proper emphasis for remedial action programs.

The term "equitable" introduces the ambiguous exposure problems associated with safety analyses through the years. These exposure factors present unusual difficulties in working with accident records within the U.S. Army because of the great variety of missions accomplished by different units, under varying sets of physical and political environments throughout the world, and with substantially different personnel resources (military personnel, Civil Service civilian personnel, and others).

The standard rate indices—for example, so many per standard unit of man-hours or per unit of use—are somewhat useful for comparing performance by same units, in similar circumstances, over a period of time. However, they are of limited use in comparing performance of substantially dissimilar units. These standard rate indices may, in fact, be misleading if the mission of the organizational unit and the circumstances in which it must carry out this mission are not fully considered. For purposes of causal analyses, "a man-day is not a man-day, is not a man-day" and "a vehicle mile is not a vehicle mile, is not a vehicle mile."

While reviewing comparative accident experience by organizational units has uncertainties, yet it does provide some indications of relative highs and lows which may be examined more intensively through other means. The available exposure indices must be used in making these comparisons even though admittedly there are inherent inadequacies. In terms of this project, only gross exposure measures were available in terms of man-days worked by various personnel categories and the number of Army motor vehicle miles driven. While it would be wrong to attribute too much importance to these intergroup differences, it was felt that consideration of these data by personnel familiar with the various environments in which the various units operate might be helpful.

The accident data analyses developed by computer and submitted previously and separately to the monitoring agency showed accident experience in terms of both raw frequencies and percentages. Since the percentage data offer more readily comparable data between units, available exposure data were also translated into percentages. The data regarding man-days for military, civilian, and other personnel, as well as the number of vehicle miles driven by Army motor vehicles, were supplied by the Army Safety Division.

Number of Accidents

The determination for number of accidents was made on the basis of the number of Cards Number 1 since the occurrence of each reportable accident initiates the creation of such a card. The involvement of multiple persons or property owned by several different reportable owners in any given accident occurrence would appear on Cards Number 2 and upward.

Table 1 shows comparative data for various major commands of the Army. The percentage base for the data shown is worldwide with the exception of Vietnam and a few units having a contingent of Army personnel as part of a multiservice personnel force. Table 2 shows the same type of data but the percentage base includes all commands. The basic criteria of the number of Army motor vehicle accidents, number of private motor vehicle accidents, and number of other accidents are shown in this manner in order to give some indication of Vietnam experience in relation to all other. The Vietnam data are not, however, included in the Overseas Command total but are shown as a separate entry. All future figures exclude the Vietnam data from the percentage base.

Army Motor Vehicle Accidents vs. Army Motor Vehicle Mileage. The most direct comparison would seem to be between the number of Army motor vehicle accidents and the number of Army motor vehicle miles driven. Examination of these two data columns shows that there does not appear to be a close relationship between this gross measure of exposure and the number of Army motor vehicle accidents. The data reveal that overseas commands have 56.9% of accidents yet drive only 40.6% of the miles. Almost all of this difference is attributable to the experience of the U.S. Army, Europe (USAREUR). Within USAREUR the Seventh U.S. Army was charged with 70% of the command's Army motor vehicle accidents while accounting for only 45% of the command's Army motor vehicle miles driven.

Examination of other overseas commands shows that for the U.S. Army, Alaska (USARAL) and the U.S. Armed Forces Southern Command (USARSO), mileage percentage approximates that of number of accidents, while for the U.S. Army, Pacific (USARPAC), the percentage of accidents is smaller than the percentage for mileage. The data from Table 2 indicate that Vietnam showed similar experience.

Whether these data represent a relatively good or a relatively poor accident rate for the commands involved is impossible to determine from these data alone. Many factors over which command personnel have little or no control might account for the differences obtained. Weather factors, for instance, play a part, but weather as a cause of accidents was judged to be not a contributing factor in approximately 85% of the cases. The type of road network over which the Army motor vehicle mileage was driven might be another contributing factor, but the present Army accident reporting system has no data on this factor. Any studies on relationship between type or condition of road network and accident experience would require special data collection.

The type of vehicles driven could also have a causal relationship with number of accidents. Information on the types of vehicles involved in the accidents could be derived from the Army Accident Record tape, although the data were not summarized in that manner for this study. Mileage figures for the different types of vehicles do not seem

Table 1

Distribution of Number of Accidents Excluding Vietnam[a]

Command	Percent of Military Man-Days	Percent of Civil Service Civilian Man-Days	Percent of Other Army Personnel Man-Days	Percent of Army Motor Vehicle Miles Driven	Percent of Army Motor Vehicle Accidents (N = 10,276)	Percent of Private Motor Vehicle Accidents (N = 3,338)	Percent of Other Accidents[b] (N = 16,658)
Overseas Commands	26.5	5.5	46.8	40.6	56.9	22.7	32.3
USAREUR	18.3	1.6	21.6	26.7	47.0	19.9	23.9
Seventh Army	13.7	0.1	1.2	12.1	32.9	14.0	12.6
USARPAC	6.5	2.7	23.9	11.7	7.4	1.6	6.0
Eighth Army	4.0	0.4	14.8	7.0	4.7	0.1	3.2
USARAL	1.1	0.7	0.3	1.0	1.5	0.8	1.5
USARSO	0.7	0.4	1.1	1.3	1.0	0.4	0.9
CONUS	73.2	94.4	53.2	59.2	42.8	76.6	68.6
CONARC	62.3	31.3	24.4	34.6	28.1	64.1	54.7
MDW and CONARC n. e. c.	0.9	1.1	0.2	0.6	0.8	1.7	1.3
First Army	15.0	9.5	8.0	8.6	6.7	12.3	8.3
Third Army	18.9	7.7	6.1	9.9	8.4	21.4	19.8
Fourth Army	13.1	5.4	4.3	7.0	4.7	14.7	11.6
Fifth Army	7.5	4.2	2.3	4.4	4.1	7.8	7.4
Sixth Army	7.0	3.4	3.4	4.1	3.4	6.2	5.0
USAMC	1.2	46.8	16.5	13.5	4.4	1.8	4.4
USACDC	0.4	0.3	0.1	0.2	0.3	0.5	0.1
USASCC	2.1	1.1	1.0	2.4	2.9	1.6	1.2
USASA	2.3	0.3	1.1	1.2	1.4	3.1	1.3
USAINTC	0.2	0.2	0.0	1.1	1.1	0.2	0.0
ARADCOM	1.4	0.1	1.0	1.4	1.5	3.9	0.7
MTMTS	0.1	1.8	0.9	0.3	0.1	0.0	2.2
HQDA	1.4	6.0	3.9	2.6	2.0	0.2	1.0
ENGRS	0.1	3.8	7.2	1.7	0.7	0.2	1.6
TSG	1.7	2.8	0.1	0.3	0.3	1.0	1.4

[a]Basis for percentages is U.S. Army worldwide with the exception of Vietnam and a few multiservice organizations.
[b]Other includes all non-motor vehicle accidents except aircraft.

Table 2

Distribution of Number of Accidents Including Vietnam

Command	Percent of Military Man-Days	Percent of Civil Service Civilian Man-Days	Percent of Other Army Personnel Man-Days	Percent of Army Motor Vehicle Miles Driven	Percent of Army Motor Vehicle Accidents (N = 11,575)	Percent of Private Motor Vehicle Accidents (N = 3,357)	Percent of Other Accidents[a] (N = 18,186)
Overseas Commands	22.5	5.5	39.5	33.0	50.5	22.6	29.8
USAREUR	15.5	1.6	18.2	21.7	41.6	19.8	22.1
Seventh Army	11.6	0.1	1.1	9.8	29.2	13.9	11.6
USARPAC	5.5	2.7	20.2	9.5	6.6	1.6	5.5
Eighth Army	3.4	0.4	12.5	5.7	4.2	0.1	2.9
USARAL	0.9	0.7	0.2	0.8	1.3	0.8	1.4
USARSO	0.6	0.4	0.9	1.0	1.0	0.4	0.9
CONUS	62.2	94.3	44.9	48.2	38.1	76.7	61.7
CONARC	52.9	31.3	20.6	28.2	25.1	63.7	48.8
MDW and CONARC n. o. c.	0.8	1.1	0.2	0.5	0.4	0.4	0.3
First Army	12.7	9.4	6.3	7.0	5.9	12.2	7.6
Third Army	16.0	7.7	5.2	8.1	7.5	21.3	18.1
Fourth Army	11.1	5.4	3.7	5.7	4.2	14.6	10.7
Fifth Army	6.4	4.2	2.0	3.6	3.7	7.7	6.7
Sixth Army	6.0	3.4	2.9	3.3	3.1	6.1	4.5
USAMC	1.0	46.7	13.9	11.0	3.9	1.9	4.0
USACDC	0.4	0.3	0.1	0.2	0.2	0.6	0.1
USASCC	1.8	1.1	0.8	2.0	2.6	1.6	1.1
USASA	2.0	0.3	0.9	1.0	1.3	3.1	1.2
USAINTC	0.1	0.2	0.0	0.9	1.0	0.2	0.0
ARADCOM	1.2	0.1	0.8	1.1	1.3	3.8	0.7
MTMTS	0.1	1.8	0.8	0.2	0.1	0.0	2.1
HQDA	1.2	6.0	0.8	2.1	1.8	0.6	1.0
ENGRS	0.1	3.8	6.1	1.4	0.6	0.2	1.5
TSG	1.4	2.8	0.1	0.2	0.3	1.0	1.3
VIETNAM	15.1	0.2	15.6	18.6	11.4	0.7	8.5

[a]Other includes all non-motor vehicle accidents except aircraft.

to be available in any form; so, again, any study seeking relationships between these factors would have to generate exposure data from outside the Army accident record system.

Traffic flow characteristics of the traffic system in which the Army motor vehicle mileage was accumulated most probably were a factor in actual accident experience. The extent to which these traffic flow characteristics were similar or dissimilar between commands is not known. The present Army accident recording system does not attempt to include this factor.

Data regarding the number of Army motor vehicle accidents and Army motor vehicle miles driven by command illustrate several characteristics of the present accident reporting system. In terms of supplying data for describing, in an inventory sense, the accident episodes that actually occurred, the system is effective. However, in terms of supplying data for the determination of specific causal factors and relationships, the system is inadequate. Indices of the population at risk are almost totally missing. The system at present is almost exclusively an error-reporting procedure. Even if such indices of the population at risk were available, the means for tying them in directly with the error measures reported are not satisfactory. The system provides inventory counts of error occurrence and descriptive characteristics associated with such occurrence, but little dynamic information about human behavior, machine component function, or environmental characteristics. Analyses of the classical man/machine/environment elements of a total system, based solely on the data in the present accident reporting and recording system, must therefore be extremely limited.

Army Motor Vehicle Accidents vs. Man-Days. Comparison of the numbers of accidents in overseas and U.S. commands indicates even more dramatic differences when the Military Man-Days category is used as an exposure measure. For overseas, the accident experience is more than twice that which would be expected on the basis of military man-days alone. Again, USAREUR involvement is at a rate almost three times its military manpower base. All overseas commands, with the exception of Vietnam, showed more motor vehicle accidents than would have been expected solely on the basis of military man-days.

In attempting to examine this type of finding further, problems again arise from the fact that the present record system does not include comparative exposure data that could be used in evaluating intergroup experience. The number of miles driven by various types of personnel in Army motor vehicles is not routinely collected within the organized system and is not made a part of the master Army Accident Record tape. Furthermore, the gross figure of Vehicle Miles, without further breakdown by type of vehicle and the conditions under which the vehicle is driven, is totally inadequate for any type of causal analyses.

On the basis of these distributional data the number of Army motor vehicle accidents seems to bear little relationship either to the Civil Service civilian man-days or to man-days of contractor, foreign, and other personnel, and there seems to be little reason why it should.

Private Motor Vehicle Accidents. Intergroup comparisons on the basis of private motor vehicle accidents present a dramatically different picture. In this case overseas commands do not show the overcontribution to accidents that they showed for Army motor vehicle accidents. The most striking single factor about the distribution of private motor vehicle accidents is the degree to which it parallels that of military man-days. In all cases, with the exception of Vietnam where opportunities for private drivers are relatively limited, the percentage of private motor vehicle accidents is no more than five points from the equivalent military man-days, and in most cases is considerably closer. Thus, the incidence of private motor vehicle accidents appears to be concomitant with military manpower.

In order to interpret this in terms of potential causality, data regarding several assumptions would be useful. Is a military person in one command as likely to have access to a private motor vehicle as in all other commands? How many miles are likely to be driven by each military person in the various commands? How similar or dissimilar would be the general environmental conditions surrounding the use of private automotive vehicles in the various commands?

No data on these and related factors are recorded in the present system; consequently, interpretation of the experienced concomitant relationship is extremely tenuous. For the lack of any contrary evidence, a tempting hypothesis is that a command can expect private motor vehicle accidents roughly in proportion to its military strength unless conditions are such that personal driving is severely limited.

Other Accidents. Throughout this report, the Other Accidents category includes all non-motor vehicle accidents except aircraft accidents. The distribution of these accidents looks very similar to that of private motor vehicle accidents. Within the overseas command and Continental Army Command (CONARC) there is a perfect rank-order correlation between these two distributions. In other commands within the Continental United States (CONUS) there are rank-order differences, but actual differences are small. While the percentages of other accidents are not quite as close to military man-days as for private motor vehicle accidents, there appears to be a strong concomitant relationship between other accidents and military manpower.

The conclusions drawn so far have been on the basis of review of distributional data based on frequency of occurrence. Four types of general exposure data have been shown: Three represent manpower indices in terms of man-days for various classes of personnel, and one represents a rate of equipment usage. The conclusions reached would seem to indicate that the Army motor vehicle use rate is a useful, though imperfect index of Army motor vehicle accidents. It also appears that military man-days is an excellent index of the number of private motor vehicle accidents as well as a fairly good index of the number of non-motor vehicle/non-aircraft accidents.

Regression Analysis. A regression analysis based on the command distributional data was accomplished in order to determine more fully what the relationships were between the gross exposure data and the criterion data regarding the number of accidents. The relationships between the three basic criterion variables are shown in Table 3.

Table 3 indicates a rather high relationship between private motor vehicle accidents and other accidents. It also indicates a relatively high relationship between Army motor vehicle accidents and the other two classes of accidents. This would suggest that few discriminating differences would be found between accident experience for different types of accidents within a given organizational unit.

Table 3

Intercorrelations of Criterion Variables

	Number of Army Motor Vehicle Accidents	Number of Private Motor Vehicle Accidents
Number of Private Motor Vehicle Accidents	.55	
Number of Non-motor Vehicle Non-aircraft Accidents	.62	.89

In order to better understand the relationships between the general exposure indices (man-day data for military personnel, for Civil Service civilian personnel, for other Army personnel such as contractor employees and foreign direct and indirect hirees, and for the number of miles driven by Army motor vehicles) and various accident experience criterion variables, a series of multiple correlations were calculated. Each multiple in this series predicted a single criterion variable utilizing the general exposure data as predictor variables. The detailed computer output of this series of multiple correlation analyses, as well as a complete intercorrelation matrix, was submitted to the sponsor as a separate item. These data are not repeated in this report. Table 4 summarizes the zero order correlation coefficients between the exposure indices and various accident experience criterion variables.

Review of the multiple regressions involving number of accidents shows the following: The major predictor of Army motor vehicle accidents is Army motor vehicle mileage. This variable alone accounts for about half of the total variance. If the mileage variable is considered along with man-day variables, 90% of the total variance is accounted for, and the mileage variable carries the largest weight. Basically it appears that the mileage variable is the main concomitant correlate of the number of Army motor vehicle accidents. However, this does not necessarily mean it is the cause of accidents, because in the interpretation of correlation data, concomitance does not necessarily mean causality. The correlational data merely express the existence of a relationship in the data at hand.

The picture changes somewhat when the regression data for the number of private vehicle accidents and other accidents are examined. The major predictor of private motor vehicle accidents is military man-days. This variable alone accounts for 94% of the overall variance. If this variable is considered with other man-day and mileage data, the amount of variance accounted for is increased only to 95%. Basically, military man-days is the main correlate of private motor vehicle accidents. Since military man-days is really a close index of the number of military personnel assigned to an organizational unit, private motor vehicle accidents can be expected to occur in rough proportion to the number of military personnel assigned.

The major predictor of other accidents is also military man-days although the relationship is not quite as strong as with private motor vehicle accidents. Military man-days accounts for 82% of the total variance. If other man-day and mileage variables are considered, 89% of the variance can be accounted for, with military man-days drawing the heaviest weight. Again, other accidents can be expected to occur, by and large, in accordance with the number of military personnel assigned.

The type of regression results in which such a large proportion of the criterion variance is accounted for by a few variables would ordinarily please the analyst. However, this is not necessarily true in this project. In over-simplified terms, what these results indicate is that accidents are happening where people are working and where motor vehicles are being used. Little variance is left to be potentially accounted for by specific variables that could form the focus for specific remedial action programs. With so much of the variance accounted for by such general exposure indices, there is little probability of identifying specific human factors or equipment and design characteristics or combinations thereof that would be useful in directing the development and operation of remedial programs. Another general conclusion that might be reached is that accident experience of the various commands is controlled mostly by mission-oriented factors over which the organizations themselves have little control.

Table 4

Relation of General Exposure Variables to Accident Experience Variables

	Military Man-Days	Civil Service Civilian Man-Days	Other Army Personnel Man-Days	Army Motor Vehicle Mileage
Civil Service Civilian Man-Days	.04			
Other Army Man-Days	.14	.48		
Army Motor Vehicle Mileage	.60	.50	.76	
Number of Army Motor Vehicle Accidents	.58	−.01	.23	.71
Number of Private Motor Vehicle Accidents	.97	.06	.10	.58
Number of Other Accidents	.91	.14	.36	.76
Military Personnel—Army Motor Vehicle Accidents	.62	−.08	.10	.62
Civil Service Personnel—Army Motor Vehicle Accidents	.16	.97	.46	.50
Other Personnel—Army Motor Vehicle Accidents	.05	.18	.76	.69
Military Personnel—Other Accidents	.95	.01	.08	.56
Civil Service Personnel—Other Accidents	.30	.91	.38	.48
Other Personnel—Other Accidents	.05	.11	.73	.59
Military Fatalities—Army Motor Vehicle Accidents	.53	−.17	.10	.53
Civil Service Fatalities—Army Motor Vehicle Accidents	.29	.01	−.06	.04
Other Fatalities—Army Motor Vehicle Accidents	.12	−.07	.61	.49
Military Fatalities—Other Accidents	.95	.09	.16	.60
Civil Service Fatalities—Other Accidents	−.01	.97	.49	.49
Other Fatalities—Other Accidents	−.20	.77	.65	.44
Military Personal Injury—Army Motor Vehicle Accidents	.58	−.08	.07	.57
Civil Service Personal Injury—Army Motor Vehicle Accidents	.01	.95	.46	.43
Other Personal Injury—Army Motor Vehicle Accidents	.30	.02	.73	.77
Military Personal Injury—Other Accidents	.94	.00	.06	.55
Civil Service Personal Injury—Other Accidents	.36	.88	.36	.47
Other Personal Injury—Other Accidents	.03	.05	.70	.55
Military Personnel—All Private Motor Vehicle Accidents	.97	.04	.09	.59
Civil Service Personnel—All Private Motor Vehicle Accidents	.96	.07	.11	.55
Other Personnel—All Private Motor Vehicle Accidents	.97	.04	.09	.58

Personnel Involvement in Non-Aircraft Accidents

Results previously discussed relate to the number of accidents experienced without regard to the severity in terms of property damage, the number of people involved, or whether a fatality, personal injury, or property damage was involved. Discussions in the next few sections concern data regarding personnel involvement in all accidents and

separately for fatal and personal injury accidents only where the numbers warrant it. Both distributional and regression analyses were made and are discussed concurrently.

Army Motor Vehicle Accidents. A review of the data in Table 5 indicates that most Army motor vehicle accidents involve military personnel. This is to be expected because the present recording system is oriented primarily toward Army property, which in most cases is operated by U.S. Army military personnel. In a comparison of military personnel involvement and number of Army motor vehicle miles driven, the data show that overseas commands as a whole are the largest contributor to involvement, despite the fact that CONUS commands traveled more vehicle miles. Again, this disproportionate involvement seems to be mainly due to the Seventh Army and USAREUR as a whole The involvement of military personnel from USARPAC in overall Army motor vehicle accidents is relatively less than motor vehicle mileage and just about equal to military man-days. Tables 6 and 7, however, show there is a difference when fatal accidents and personal injury only accidents are considered. While these numbers are considerably smaller (fatalities = 77; injuries = 1,145), the sample size is large enough for indicative if not definitive results.

USARPAC military personnel involvement in fatal Army motor vehicle accidents exceeded expectations based on both mileage and military man-days. Their involvement in personal injury accidents also considerably exceeded expectations on the basis of military man-days but was much closer to, though somewhat less than, expectations based on mileage.

Review of the regression analyses shows that mileage driven and military man-days were about equally predictive of military personnel involvement in overall Army motor vehicle accidents. Each variable, individually, accounts for 39% of the total variance. The two variables, in combination, account for 48% of the variance, each receiving about equal weight. When the two variables are combined with Civil Service and other civilian man-day data, 87% of the variance is accounted for; in this case the mileage variable receives the most weight. Thus, military involvement in overall motor vehicle accidents is most closely associated with miles driven, but because of the substantial relationship between military man-days and mileage, the former is also a potent (but not as potent) predictor of such involvement.

When only fatal Army motor vehicle accidents are considered, the same two variables, singly, again predominate, accounting about equally—29% and 28% respectively—of the total variance. When all man-day and mileage variables are considered, 74% of the variance in military personnel involvement is accounted for, and mileage is the most heavily weighted variable. About the same holds true when personal injury accidents only are considered. Individually, the mileage and military man-day variables account for 32% and 34% of the total variance. When all man-day and mileage data are considered, 79% of the variance of military personnel involvement in injury accidents is accounted for, and mileage again is the most heavily weighted variable.

Overall, it appears that military involvement in Army motor vehicle accidents is primarily accounted for by the number of miles driven, but it is also considerably affected by the number of military personnel assigned.

The picture is somewhat different when one examines civilian Civil Service personnel involvement in Army motor vehicle accidents. Number of Civil Service man-days is the main predictor of overall involvement, singly accounting for 94% of the variance. This changes to only 96% of the variance accounted for when other man-day and mileage variables are taken into account, and Civil Service man-days is by far the most heavily weighted. The same type of pattern emerges when injury accidents alone are considered, although the number involved is so small that reliable interpretation is difficult. The number of Civil Service fatalities is too small even to attempt to make a relational analysis.

Table 5

Distribution of Personnel Involved in Army Motor Vehicle Accidents[a]

Command	Percent of Military Man-Days	Percent of Civil Service Civilian Man-Days	Percent of Other Army Personnel Man-Days	Percent of Army Motor Vehicle Miles Driven	Percent of Personnel Involved		
					Military (N=11,131)	Civil Service Civilian (N=646)	Other Army Personnel (N = 955)
Overseas Commands	26.5	5.5	46.8	40.6	49.7	0.2	5.1
USAREUR	18.3	1.6	21.6	26.7	40.8	0.0	4.2
Seventh Army	13.7	0.1	1.2	12.1	31.7	0.0	0.6
USARPAC	6.5	2.7	23.9	11.7	6.7	0.1	0.8
Eighth Army	4.0	0.4	14.8	7.0	4.2	0.0	0.4
USARAL	1.1	0.7	0.3	1.0	1.4	0.1	0.0
USARSO	0.7	0.4	1.1	1.3	0.8	0.0	0.1
CONUS	73.2	94.4	53.2	59.2	38.0	4.9	2.1
CONARC	62.3	31.3	24.4	34.6	27.8	2.2	0.6
MDW and CONARC n.e.c.	0.9	1.1	0.2	0.6	0.7	0.1	0.0
First Army	15.0	9.5	8.0	8.6	6.6	0.6	0.0
Third Army	18.9	7.7	6.1	9.9	8.3	0.6	0.2
Fourth Army	13.1	5.4	4.3	7.0	4.5	0.2	0.2
Fifth Army	7.5	4.2	2.3	4.4	4.3	0.4	0.1
Sixth Army	7.0	3.4	3.4	4.1	3.4	0.3	0.1
USAMC	1.2	46.8	16.5	13.5	1.4	2.0	1.1
USACDC	0.4	0.3	0.1	0.2	0.3	0.0	0.0
USASCC	2.1	1.1	1.0	2.4	2.5	0.0	0.2
USASA	2.3	0.3	1.1	1.2	1.4	0.0	0.1
USAINTC	0.2	0.2	0.0	1.1	1.0	0.0	0.0
ARADCOM	1.4	0.1	1.0	1.4	1.5	0.0	0.0
MTMTS	0.1	1.8	0.9	0.3	0.0	0.1	0.0
HQDA	1.4	6.0	0.9	2.6	1.8	0.2	0.0
ENGRS	0.1	3.8	7.2	1.7	0.1	0.4	0.1
TSG	1.7	2.8	0.1	0.3	0.2	0.0	0.0

[a]Basis for percentages is U.S. Army worldwide with the exception of Vietnam and a few multiservice organizations.

Table 6

Distribution of Personnel Involved in Fatal Army Motor Vehicle Accidents[a]

Command	Percent of Military Man-Days	Percent of Civil Service Civilian Man-Days	Percent of Other Army Personnel Man-Days	Percent of Army Motor Vehicle Miles Driven	Percent of Personnel Involved		
					Military (N=77)	Civil Service Civilian (N=2)	Other Army Personnel (N=6)
Overseas Commands	26.5	5.5	46.8	40.6	54.3	0.0	6.0
USAREUR	18.3	1.6	21.6	26.7	37.7	0.0	3.6
Seventh Army	13.7	0.1	1.2	12.1	30.6	0.0	0.0
USARPAC	6.5	2.7	23.9	11.7	13.0	0.0	2.4
Eighth Army	4.0	0.4	14.8	7.0	10.6	0.0	0.0
USARAL	1.1	0.7	0.3	1.0	1.2	0.0	0.0
USARSO	0.7	0.4	1.1	1.3	2.4	0.0	0.0
CONUS	73.2	94.4	53.2	59.2	36.6	2.4	1.2
CONARC	62.3	31.3	24.4	34.6	22.4	1.2	1.2
MDW and CONARC n.e.c.	0.9	1.1	0.2	0.6	1.2	0.0	0.0
First Army	15.0	9.5	8.0	8.6	3.5	0.0	0.0
Third Army	18.9	7.7	6.1	9.9	7.1	1.2	1.2
Fourth Army	13.1	5.4	4.3	7.0	4.7	0.0	0.0
Fifth Army	7.5	4.2	2.3	4.4	4.7	0.0	0.0
Sixth Army	7.0	3.4	3.4	4.1	1.2	0.0	0.0
USAMC	1.2	46.8	16.5	13.5	0.0	0.0	0.0
USACDC	0.4	0.3	0.1	0.2	0.0	0.0	0.0
USASCC	2.1	1.1	1.0	2.4	4.7	0.0	0.0
USASA	2.3	0.3	1.1	1.2	4.7	0.0	0.0
USAINTC	0.2	0.2	0.0	1.1	0.0	0.0	0.0
ARADCOM	1.4	0.1	1.0	1.4	2.4	0.0	0.0
MTMTS	0.1	1.8	0.9	0.3	0.0	1.2	0.0
HQDA	1.4	6.0	0.9	2.6	1.2	0.0	0.0
ENGRS	0.1	3.8	7.2	1.7	1.2	0.0	0.0
TSG	1.7	2.8	0.1	0.3	0.0	0.0	0.0

[a]Basis for percentages is U.S. Army worldwide with the exception of Vietnam and a few multiservice organizations.

Table 7

Distribution of Personnel Involved in Personal Injury Army Motor Vehicle Accidents[a]

Command	Percent of Military Man-Days	Percent of Civil Service Civilian Man-Days	Percent of Other Army Personnel Man-Days	Percent of Army Motor Vehicle Miles Driven	Percent of Personnel Involved		
					Military (N = 1,145)	Civil Service Civilian (N = 33)	Other Army Personnel (N = 108)
Overseas Commands	26.5	5.5	46.8	40.6	52.9	0.4	5.6
USAREUR	18.3	1.6	21.6	26.7	41.4	0.0	3.9
Seventh Army	13.7	0.1	1.2	12.1	34.8	0.0	1.3
USARPAC	6.5	2.7	23.9	11.7	10.1	0.3	1.5
Eighth Army	4.0	0.4	14.8	7.0	5.9	0.1	1.2
USARAL	1.1	0.7	0.3	1.0	0.7	0.1	0.0
USARSO	0.7	0.4	1.1	1.3	0.7	0.0	0.2
CONUS	73.2	94.4	53.2	59.2	36.0	2.5	3.0
CONARC	62.3	31.3	24.4	34.6	26.5	0.9	1.9
MDW and CONARC n.e.c.	0.9	1.1	0.2	0.6	0.5	0.1	0.0
First Army	15.0	9.5	8.0	8.6	2.7	0.3	0.1
Third Army	18.9	7.7	6.1	9.9	10.3	0.1	0.5
Fourth Army	13.1	5.4	4.3	7.0	3.3	0.2	0.7
Fifth Army	7.5	4.2	2.3	4.4	6.4	0.2	0.2
Sixth Army	7.0	3.4	3.4	4.1	3.3	0.0	0.4
USAMC	1.2	46.8	16.5	13.5	1.7	1.0	0.5
USACDC	0.4	0.3	0.1	0.2	0.7	0.0	0.0
USASCC	2.1	1.1	1.0	2.4	3.1	0.0	0.0
USASA	2.3	0.3	1.1	1.2	1.5	0.1	0.2
USAINTC	0.2	0.2	0.0	1.1	0.2	0.0	0.0
ARADCOM	1.4	0.1	1.0	1.4	1.4	0.0	0.0
MTMTS	0.1	1.8	0.9	0.3	0.0	0.2	0.0
HQDA	1.4	6.0	0.9	2.6	0.6	0.2	0.0
ENGRS	0.1	3.8	7.2	1.7	0.2	0.1	0.4
TSG	1.7	2.8	0.1	0.3	0.1	0.0	0.0

[a]Basis for percentages is U.S. Army worldwide with the exception of Vietnam and a few multiservice organizations.

In considering the involvement of other Army personnel in Army motor vehicle accidents, it should be remembered that this category includes a component of military personnel (e.g., Reservists or National Guard while on summer camp duty), and a civilian component (including Army contractor employees as well as direct and indirect hire foreign nationals). The exact proportionate make-up of this group was not known to the AIR project staff. Even though this category of personnel accounted for little more than 7% of the total involvement in Army motor vehicle accidents, the numbers are large enough to be indicative, particularly when all motor vehicle accidents are considered.

Review of Table 5 indicates that on a relative rank-order basis, other Army personnel from the overseas commands were involved in Army motor vehicle accidents to a greater extent than would have been expected either on the basis of any of the man-day data or on the basis of mileage. Regression analysis results for this personnel category look much like those for military personnel, except the other Army personnel man-day variable replaces the military man-day variable. Considered singly, the categories of other personnel man-days and mileage are good predictors. Other personnel man-days alone accounts for 57% of the total variance. When all man-day data plus mileage are used in the prediction equation, 84% of the total variance is accounted for, and the mileage variable carries the largest weight. Basically, other Army personnel are involved in Army motor vehicle accidents where such personnel are located in large numbers, but more importantly where Army motor vehicle miles are driven. This relationship holds true for all motor vehicle accidents and for those in which personal injury was involved. The number of fatalities involving other Army personnel was too small to make any reasonable interpretations.

When the data on involvement of personnel in Army motor vehicle accidents are summarized, it appears that two factors can account for most of the variance in actual accident experience: mileage and manpower. When they are combined most of the variance is accounted for, and the mileage factor usually draws the most weight. Again, with so much of the variance accounted for by these overgeneralized exposure indices, the probabilities of finding highly significant relationships from other variables, either singly or in combination, were greatly reduced.

Private Motor Vehicle Accidents. The data concerning personnel involvement in private motor vehicle accidents are shown in Tables 8, 9, and 10. In reviewing these data, too much credence should not be placed on the data concerning Civil Service and other Army personnel because of the small numbers involved. For military personnel the number of cases, overall, is 4,552, of which 586 were fatalities and 3,485 were personal injury. For Civil Service personnel the figures were 21 overall, 1 fatality, and 14 injuries. Comparable figures for other Army personnel were 47 overall, 2 fatalities, and 25 injuries. Only the data for military personnel involvement appear to warrant any review and interpretation.

Review of the distributional data shown in Tables 8, 9, and 10 indicates that military personnel involvement in private motor vehicle accidents echoes the results found for the number of such accidents occurring. The distribution of military personnel involvement—and it doesn't make much difference whether overall or only fatal or injury accidents are considered—very closely approximates the distribution of military man-days for the commands. Military personnel appear to be involved in private motor vehicle accidents in close proportion to the number assigned to a command.

The regression analysis for overall private motor vehicle accidents substantiates this conclusion. As a single factor, military man-days accounts for more than 93% of the total variance. When other man-day and mileage factors are added to the prediction equation, the amount of variance accounted for is increased to 95%, and, as might be expected, the military man-days factor is the most heavily weighted. There seems to be little doubt that private motor vehicle accidents occur in close proportion to the number of military personnel assigned to a command.

Table 8

Distribution of Personnel Involved in Private Motor Vehicle Accidents[a]

Command	Percent of Military Man-Days	Percent of Civil Service Civilian Man-Days	Percent of Other Army Personnel Man-Days	Percent of Army Motor Vehicle Miles Driven	Percent of Personnel Involved		
					Military (N = 4,552)	Civil Service Civilian (N = 21)	Other Army Personnel (N = 47)
Overseas Commands	26.5	5.5	46.8	40.6	23.4	0.0	0.2
USAREUR	18.3	1.6	21.6	26.7	20.8	0.0	0.1
Seventh Army	13.7	0.1	1.2	12.1	14.6	0.0	0.0
USARPAC	6.5	2.7	23.9	11.7	1.5	0.0	0.1
Eighth Army	4.0	0.4	14.8	7.0	0.1	0.0	0.0
USARAL	1.1	0.7	0.3	1.0	0.8	0.0	0.0
USARSO	0.7	0.4	1.1	1.3	0.3	0.0	0.0
CONUS	73.2	94.4	53.2	59.2	75.0	0.1	0.8
CONARC	62.3	31.3	24.4	34.6	63.2	0.0	0.5
MDW and CONARC n.e.c.	0.9	1.1	0.2	0.6	1.4	0.0	0.0
First Army	15.0	9.5	8.0	8.6	11.6	0.0	0.2
Third Army	18.9	7.7	6.1	9.9	20.6	0.0	0.2
Fourth Army	13.1	5.4	4.3	7.0	14.0	0.0	0.1
Fifth Army	7.5	4.2	2.3	4.4	9.5	0.0	0.0
Sixth Army	7.0	3.4	3.4	4.1	6.1	0.0	0.0
USAMC	1.2	46.8	16.5	13.5	1.5	0.1	0.1
USACDC	0.4	0.3	0.1	0.2	0.5	0.0	0.0
USASCC	2.1	1.1	1.0	2.4	1.4	0.0	0.0
USASA	2.3	0.3	1.1	1.2	3.2	0.0	0.0
USAINTC	0.2	0.2	0.0	1.1	0.2	0.0	0.0
AFADCOM	1.4	0.1	1.0	1.4	3.5	0.0	0.0
MTMTS	0.1	1.8	0.9	0.3	0.0	0.0	0.0
HQDA	1.4	6.0	0.9	2.6	0.4	0.0	0.0
ENGRS	0.1	3.8	7.2	1.7	0.1	0.0	0.2
TSG	1.7	2.8	0.1	0.3	1.0	0.0	0.0

[a]Basis for percentages is U.S. Army worldwide with the exception of Vietnam and a few multiservice organizations.

Table 9

Distribution of Personnel Involved in Fatal Private Motor Vehicle Accidents[a]

Command	Percent of Military Man-Days	Percent of Civil Service Civilian Man-Days	Percent of Other Army Personnel Man-Days	Percent of Army Motor Vehicle Miles Driven	Percent of Personnel Involved		
					Military (N = 586)	Civil Service Civilian (N = 1)	Other Army Personnel (N = 2)
Overseas Commands	26.5	5.5	46.8	40.6	18.6	0.0	0.0
USAREUR	18.3	1.6	21.6	26.7	17.0	0.0	0.0
Seventh Army	13.7	0.1	1.2	12.1	10.9	0.0	0.0
USARPAC	6.5	2.7	23.9	11.7	0.9	0.0	0.0
Eighth Army	4.0	0.4	14.8	7.0	0.2	0.0	0.0
USARAL	1.1	0.7	0.3	1.0	0.7	0.0	0.0
USARSO	0.7	0.4	1.1	1.3	0.0	0.0	0.0
CONUS	73.2	94.4	53.2	59.2	81.1	0.2	0.4
CONARC	62.3	31.3	24.4	34.6	70.0	0.2	0.2
MDW and CONARC n.e.c.	0.9	1.1	0.2	0.6	1.7	0.0	0.0
First Army	15.0	9.5	8.0	8.6	13.6	0.0	0.2
Third Army	18.9	7.7	6.1	9.9	23.1	0.0	0.0
Fourth Army	13.1	5.4	4.3	7.0	14.6	0.2	0.0
Fifth Army	7.5	4.2	2.3	4.4	10.7	0.0	0.0
Sixth Army	7.0	3.4	3.4	4.1	6.3	0.0	0.0
USAMC	1.2	46.8	16.5	13.5	1.6	0.0	0.2
USACDC	0.4	0.3	0.1	0.2	0.8	0.0	0.0
USASCC	2.1	1.1	1.0	2.4	1.2	0.0	0.0
USASA	2.3	0.3	1.1	1.2	2.2	0.0	0.0
USAINTC	0.2	0.2	0.0	1.1	0.2	0.0	0.0
ARADCOM	1.4	0.1	1.0	1.4	4.4	0.0	0.0
MTMTS	0.1	1.8	0.9	0.3	0.0	0.0	0.0
HQDA	1.4	6.0	0.9	2.6	0.2	0.0	0.0
ENGRS	0.1	3.8	7.2	1.7	0.0	0.0	0.0
TSG	1.7	2.8	0.1	0.3	0.5	0.0	0.0

[a]Basis for percentages is U.S. Army worldwide with the exception of Vietnam and a few multiservice organizations.

Table 10

Distribution of Personnel Involved in Personal Injury Private Motor Vehicle Accidents[a]

Command	Percent of Military Man-Days	Percent of Civil Service Civilian Man-Days	Percent of Other Army Personnel Man-Days	Percent of Army Motor Vehicle Miles Driven	Percent of Personnel Involved		
					Military (N = 3,485)	Civil Service Civilian (N = 14)	Other Army Personnel (N = 25)
Overseas Commands	26.5	5.5	46.8	40.6	23.6	0.0	0.1
USAREUR	18.3	1.6	21.6	26.7	20.7	0.0	0.0
Seventh Army	13.7	0.1	1.2	12.1	14.7	0.0	0.0
USARPAC	6.5	2.7	23.9	11.7	1.6	0.0	0.1
Eighth Army	4.0	0.4	14.8	7.0	0.1	0.0	0.0
USARAL	1.1	0.7	0.3	1.0	0.9	0.0	0.0
USARSO	0.7	0.4	1.1	1.3	0.4	0.0	0.0
CONUS	73.2	94.4	53.2	59.2	75.0	0.4	0.6
CONARC	62.3	31.3	24.4	34.6	63.2	0.1	0.4
MDW and CONARC n.e.c.	0.9	1.1	0.2	0.6	1.4	0.0	0.0
First Army	15.0	9.5	8.0	8.6	11.6	0.0	0.2
Third Army	18.9	7.7	6.1	9.9	20.3	0.0	0.1
Fourth Army	13.1	5.4	4.3	7.0	14.3	0.0	0.1
Fifth Army	7.5	4.2	2.3	4.4	9.4	0.1	0.0
Sixth Army	7.0	3.4	3.4	4.1	6.2	0.0	0.0
USAMC	1.2	46.8	16.5	13.5	1.5	0.2	0.1
USACDC	0.4	0.3	0.1	0.2	0.6	0.0	0.0
USASCC	2.1	1.1	1.0	2.4	1.4	0.0	0.0
USASA	2.3	0.3	1.1	1.2	3.3	0.0	0.0
USAINTC	0.2	0.2	0.0	1.1	0.1	0.0	0.0
ARADCOM	1.4	0.1	1.0	1.4	3.4	0.0	0.0
MTMTS	0.1	1.8	0.9	0.3	0.0	0.0	0.0
HQDA	1.4	6.0	0.9	2.6	0.4	0.0	0.0
ENGRS	0.1	3.8	7.2	1.7	0.1	0.0	0.1
TSG	1.7	2.8	0.1	0.3	1.0	0.1	0.0

[a]Basis for percentages is U.S. Army worldwide with the exception of Vietnam and a few multiservice organizations.

One interpretation should be avoided: It should not be said that civilian drivers are more likely to be accident-free simply because there are so few recorded private motor vehicle accidents involving them. The recording procedure is such that most private civilian motor vehicle accidents do not qualify for inclusion in the Army record system because they occur in locations and at times when the Army has no jurisdiction. While it is undoubtedly true that some private motor vehicle accidents involving military personnel escape inclusion in the Army accident record system, the probability of inclusion is relatively high. This procedural artifact is of little concern unless there is a desire to consider various types of action programs. For example, if a program of replacing military driver with civilian driver were contemplated, there would be no way of estimating its expected effects on accident experience, except through special studies of situations in which appropriate records of civilian and military drivers operating under similar circumstances were kept. Even the data previously discussed under the civilian components of involvement in Army motor vehicles are clouded by the fact that data regarding the number of civilian drivers and passengers were not available. Although it is recognized that collecting relevant exposure data was not one of the objectives of the present system, the fact remains that the Army Safety Division is prevented from making certain analyses because of the lack of this type of data.

Other Accidents. For purposes of these analyses, Other Accidents are defined as those not classified as either motor vehicle or aircraft accidents. The data showing personnel involvement in such other accidents are shown in Tables 11, 12, and 13.

The distribution of military personnel involvement in other accidents shows a striking resemblance to the overall distribution of other accidents. This is undoubtedly due to the fact that about three out of four other accidents involve military personnel. While the preponderance of other accidents involve military personnel, it is perhaps worth noting that the approximate 75% for other accidents is smaller than the 88% for Army motor vehicle accidents and the 98% for private motor vehicle accidents.

It is also to be noted that the rank-order of the military personnel involvement is strikingly similar to the command distribution for military man-days. It makes little difference whether all other accidents are considered or if only fatal or injury accidents are involved. The regression analyses of military involvement bear this out. Military man-days alone accounts for 89% of the total variance in all other accidents. When fatal other accidents only are considered, military man-days accounts for 91% of the variance, and injury accidents for only 88% of the variance. If other man-day and mileage variables are added to the prediction equation, the respective amounts of variance accounted for are 91%, 91%, and 90%. In all cases, the military man-day variable is the most heavily weighted in the regression equation. Again it appears that other accidents involve military personnel roughly in proportion to the number of personnel assigned. And again it appears that since such a large portion of the variance can be accounted for in terms of such a gross exposure index, the probabilities of finding other variables that singly or in combination will substantially affect accident experience are small.

Examination of Civil Service involvement in other accidents shows a close rank-order relationship between accident involvement and Civil Service man-days. The majority of the Civil Service manpower is expended by U.S. commands, and the majority of other accidents involves U.S. commands. The ratio of other accidents to man-days is somewhat higher for U.S. commands than it is for overseas commands. The U.S. Army Materiel Command (USAMC) and CONARC are major users of Civil Service manpower. CONARC has a higher involvement in overall other accidents and injury accidents but USAMC has a higher relative involvement in fatalities, although this specific figure is based on very few cases. Again it appears that involvement in other accidents by Civil Service personnel occurs in rough proportion to the numbers utilized.

Table 11

Distribution of Personnel Involved in Other Accidents[a, b]

Command	Percent of Military Man-Days	Percent of Civil Service Civilian Man-Days	Percent of Other Army Personnel Man-Days	Percent of Army Motor Vehicle Miles Driven	Percent of Personnel Involved		
					Military (*N* = 12,835)	Civil Service Civilian (*N* = 1,527)	Other Army Personnel (*N* = 3,206)
Overseas Commands	26.5	5.5	46.8	40.6	22.0	0.3	10.0
USAREUR	18.3	1.6	21.6	26.7	15.3	0.0	8.5
Seventh Army	13.7	0.1	1.2	12.1	12.2	0.0	0.3
USARPAC	6.5	2.7	23.9	11.7	4.5	0.2	1.4
Eighth Army	4.0	0.4	14.8	7.0	2.7	0.0	0.6
USARAL	1.1	0.7	0.3	1.0	1.4	0.1	0.0
USARSO	0.7	0.4	1.1	1.3	0.8	0.0	0.1
CONUS	73.2	94.4	53.2	59.2	51.8	8.2	8.0
CONARC	62.3	31.3	24.4	34.6	47.0	4.1	3.1
MDW and CONARC n.e.c.	0.9	1.1	0.2	0.6	1.0	0.1	0.0
First Army	15.0	9.5	8.0	8.6	6.2	1.1	1.0
Third Army	18.9	7.7	6.1	9.9	18.3	0.9	0.6
Fourth Army	13.1	5.4	4.3	7.0	9.8	0.8	1.1
Fifth Army	7.5	4.2	2.3	4.4	6.6	0.6	0.1
Sixth Army	7.0	3.4	3.4	4.1	4.1	0.5	0.3
USAMC	1.2	46.8	16.5	13.5	0.5	2.3	1.6
USACDC	0.4	0.3	0.1	0.2	0.1	0.0	0.0
USASCC	2.1	1.1	1.0	2.4	1.0	0.0	0.1
USASA	2.3	0.3	1.1	1.2	1.2	0.0	0.0
USAINTC	0.2	0.2	0.0	1.1	0.0	0.0	0.0
ARADCOM	1.4	0.1	1.0	1.4	0.7	0.0	0.0
MTMTS	0.1	1.8	0.9	0.3	0.0	0.4	1.8
HQDA	1.4	6.0	0.9	2.6	0.4	0.6	0.0
ENGRS	0.1	3.8	7.2	1.7	0.0	0.3	1.4
TSG	1.7	2.8	0.1	0.3	0.9	0.5	0.0

[a]Basis for percentages is U.S. Army worldwide with the exception of Vietnam and a few multiservice organizations.
[b]Other includes all non-motor vehicle accidents except aircraft.

Table 12

Distribution of Personnel Involved in Fatal Other Accidents[a, b]

Command	Percent of Military Man-Days	Percent of Civil Service Civilian Man-Days	Percent of Other Army Personnel Man-Days	Percent of Army Motor Vehicle Miles Driven	Percent of Personnel Involved		
					Military (N = 212)	Civil Service Civilian (N = 13)	Other Army Personnel (N = 52)
Overseas Commands	26.5	5.5	46.8	40.6	21.4	0.4	4.4
USAREUR	18.3	1.6	21.6	26.7	13.8	0.0	2.5
Seventh Army	13.7	0.1	1.2	12.1	11.6	0.0	0.0
USARPAC	6.5	2.7	23.9	11.7	6.2	0.4	1.9
Eighth Army	4.0	0.4	14.8	7.0	4.7	0.0	0.7
USARAL	1.1	0.7	0.3	1.0	1.4	0.0	0.0
USARSO	0.7	0.4	1.1	1.3	0.0	0.0	0.0
CONUS	73.2	94.4	53.2	59.2	56.2	4.4	14.6
CONARC	62.3	31.3	24.4	34.6	48.3	1.1	1.2
MDW and CONARC n.e.c.	0.9	1.1	0.2	0.6	1.4	0.0	0.0
First Army	16.0	9.5	8.0	8.6	13.4	0.7	0.4
Third Army	18.9	7.7	6.1	9.9	13.0	0.0	0.0
Fourth Army	13.1	5.4	4.3	7.0	5.8	0.4	0.4
Fifth Army	7.5	4.2	2.3	4.4	7.2	0.0	0.0
Sixth Army	7.0	3.4	3.4	4.1	6.1	0.0	0.4
USAMC	1.2	46.8	16.5	13.5	2.1	3.3	7.6
USACDC	0.4	0.3	0.1	0.2	0.0	0.0	0.0
USASCC	2.1	1.1	1.0	2.4	2.2	0.0	0.0
USASA	2.3	0.3	1.1	1.2	1.1	0.0	0.0
USAINTC	0.2	0.2	0.0	1.1	0.0	0.0	0.0
ARADCOM	1.4	0.1	1.0	1.4	1.8	0.0	0.0
MTMTS	0.1	1.8	0.9	0.3	0.0	0.0	0.7
HQDA	1.4	6.0	0.9	2.6	0.0	0.0	0.0
ENGRS	0.1	3.8	7.2	1.7	0.0	0.0	5.1
TSG	1.7	2.8	0.1	0.3	0.7	0.0	0.0

[a]Basis for percentages is U.S. Army worldwide with the exception of Vietnam and a few multiservice organizations.
[b]Other includes all non-motor vehicle accidents except aircraft

Table 13

Distribution of Personnel Involved in Personal Injury Other Accidents[a,b]

Command	Percent of Military Man-Days	Percent of Civil Service Civilian Man-Days	Percent of Other Army Personnel Man-Days	Percent of Army Motor Vehicle Miles Driven	Percent of Personnel Involved		
					Military (*N* = 11,191)	Civil Service Civilian (*N* = 1,336)	Other Army Personnel (*N* = 2,727)
Overseas Commands	26.5	5.5	46.8	40.6	21.7	0.3	10.6
USAREUR	18.3	1.6	21.6	26.7	15.4	0.0	9.2
Seventh Army	13.7	0.1	1.2	12.1	12.7	0.0	0.3
USARPAC	6.5	2.7	23.9	11.7	4.1	0.2	1.3
Eighth Army	4.0	0.4	14.8	7.0	2.3	0.0	0.5
USARAL	1.1	0.7	0.3	1.0	1.4	0.1	0.0
USARSO	0.7	0.4	1.1	1.3	0.8	0.0	0.1
CONUS	73.2	94.4	53.2	59.2	52.4	8.4	7.0
CONARC	62.3	31.3	24.4	34.6	47.7	4.6	2.5
MDW and CONARC n.e.c.	0.9	1.1	0.2	0.6	1.1	0.2	0.0
First Army	15.0	9.5	8.0	8.6	6.0	1.2	1.1
Third Army	18.9	7.7	6.1	9.9	18.7	0.9	0.5
Fourth Army	13.1	5.4	4.3	7.0	9.4	0.9	0.6
Fifth Army	7.5	4.2	2.3	4.4	7.0	0.7	0.1
Sixth Army	7.0	3.4	3.4	4.1	4.4	0.5	0.2
USAMC	1.2	46.8	16.5	13.5	0.4	2.1	1.2
USACDC	0.4	0.3	0.1	0.2	0.1	0.0	0.0
USASCC	2.1	1.1	1.0	2.4	1.0	0.0	0.2
USASA	2.3	0.3	1.1	1.2	1.3	0.0	0.0
USAINTC	0.2	0.2	0.0	1.1	0.0	0.0	0.0
ARADCOM	1.4	0.1	1.0	1.4	0.6	0.0	0.0
MTMTS	0.1	1.8	0.9	0.3	0.0	0.3	1.8
HQDA	1.4	6.0	0.9	2.6	0.3	0.6	0.0
ENGRS	0.1	3.8	7.2	1.7	0.0	0.3	1.3
TSG	1.7	2.8	0.1	0.3	1.0	0.5	0.0

[a]Basis for percentages is U.S. Army worldwide with the exception of Vietnam and a few multiservice organizations.
[b]Other includes all non-motor accidents except aircraft.

Regression analyses of these data indicate that Civil Service man-days alone accounts for 84% of all other accidents, 94% of fatal other accidents, and 78% of personal injury variance. If all man-day and mileage variables are used in the prediction equations, the respective percentages of variance accounted for become 95, 95, and 94.

Examination of the involvement of other Army personnel in other accidents indicates that the distribution is somewhat the same as both other Army personnel man-days and Army motor vehicle mileage. The overseas commands involvement is somewhat in excess of expectations based on either other personnel man-days or mileage driven. Most of this is accounted for by USAREUR whose involvement alone more than equals that of all CONUS commands, although it has less man-days or mileage. This holds true overall and for fatal and injury accidents separately.

The regression analyses concerning other Army personnel involvement in other accidents are less clear cut than previous analyses. When overall other accidents are involved, man-days of other Army personnel singly accounts for 53% of the variance. When combined with other man-day and mileage variables, however, the amount of variance accounted for jumps to 69%, but the mileage variable gets the heaviest weight. When injury-only other accidents are considered, the respective amounts of variance accounted for are 49% and 68%, and mileage again receives the greatest weight in the multiple. When fatal-only other accidents are considered, another factor comes into play. The best single predictor then becomes the Civil Service man-days which singly accounts for 60% of the variance. Other personnel man-days is also a good single predictor, but it accounts for only 43% of the variance. When all man-day and mileage variables are thrown into the prediction equation, 79% of the variance is accounted for, but Civil Service man-days receives the highest weight.

While the fatal cases number only 52, the relationship is hard to explain on an *a priori* basis. While there is a bit more ambiguity about the involvement of other Army personnel in other accidents, there appears to be a fairly strong relationship between the number of such personnel working in a command and their involvement in other accidents. For some reason not immediately apparent, this relationship is made obvious by a relatively high correlation (.76) between other Army personnel man-days and Army motor vehicle mileage.

Summary of Personnel Involvement Data. The general conclusions to be drawn from the data concerning the involvement of different types of personnel are much the same as those drawn from the data concerning the number of accidents that occurred. Various classes of personnel seem to get involved in the different types of accidents roughly in proportion to the numbers assigned to an organizational unit. Where a usage index was available, as in the case of Army motor vehicle mileage, it also exerted a potent effect on its face valid correlate, namely, Army motor vehicle accidents. With some exceptions in the case of other accidents, the greater part of the variance in experienced accident involvement was accounted for by rather overgeneralized personnel and usage exposure factors. The prognosis for identifying potent factors elsewhere was, therefore, not good.

Summary of Interorganizational Unit Comparisons

The data concerning accident experience by major Army commands were examined, utilizing two different approaches. Direct comparisons of intercommand experience were made by comparing equivalent percentage distributions. This reveals what appears to be a slight overinvolvement in several types of accidents by the overseas commands. The data indicate that much of this is due to the experience of USAREUR and particularly the Seventh Army. Neither the distributional data nor the regression data suggest any reason why this is so. The extent to which these results are due to differences in the geographic, political, and social environment, in mission orientation, or in general methods of

operation, cannot be determined from the data in the present Army accident record system because it is mainly an error counting system and does not presently include data on these variables.

The regression data by themselves are rather disheartening because of the large proportion of the variance that can be accounted for by the rather simplified and overgeneralized exposure indices used. While it is possible that potent relationships of single factors and combinations of factors could be teased out from an analysis of their relationship to the general exposure indices, the task would obviously be difficult and tedious. It also became obvious that regression analyses utilizing only the information within the present error counting system would not be likely to lead to many causal interpretations since little or no data were available regarding the population at risk. An attempt to overcome this situation was made by examining some of the variables utilizing a method developed by Thorpe based on the assumption of innocent and culpable involvement in accidents.

COMPARISONS OF RELATIVE INVOLVEMENT USING INDIRECT MEASURES OF EXPOSURE

In order to overcome the persistent problem of lack of appropriate exposure data, Thorpe devised a method for calculating the likelihood of particular driver-vehicle combinations to be involved in accidents using only the proportions of particular driver-vehicle combinations found in single vehicle accidents and in collision accidents. The method is based on several assumptions, the principal two of which are as follows:

1. The responsibility for a single vehicle accident is that of the driver-vehicle combination concerned.
2. Collision accidents are caused by the first two vehicles to hit and in each such accident there will be a "responsible" and a "not responsible" driver-vehicle combination.

It is recognized, of course, that the assumption regarding the all-or-nothing division of responsibility would not always be true since the responsibility for many accidents is shared between two participating combinations in equal or unequal proportions. This should tend to be a compensating error, for if a particular combination is less than 100% responsible in some accidents and more than 0% in others, this particular driver-vehicle combination will tend to appear in fewer accidents as the "responsible" combination and in more accidents as the "not responsible" combination. Checks using Australian road data showed reasonable agreement between relative accident likelihoods determined by the method proposed and by calculating the same involvement index by normal methods.

The basic hypothesis of "innocent" involvement in a particular type of accident as an index of the probability of the "accident situation" occurring is an intriguing one, with some face validity as well as the preliminary validation indicated by Thorpe. The only thing needed was a determination of innocent involvement. The Army accident record system has a sort of a built-in responsibility index in that unsafe acts and unsafe personal factors are coded if they are felt to be associated with a given accident, and they are not coded if they were not deemed to be associated with the accident. It was decided, therefore, to calculate some comparable innocent and culpable distributions for several personnel-related variables. If one accepts the basic hypothesis of the innocent distribution as an exposure index, then the culpable distribution would show experience at variance with basic exposure. In each case "innocent" was defined as a personnel involvement for which neither an unsafe act nor an unsafe personal factor was recorded. "Culpable" included all personnel involvement cases for which either an unsafe act or an unsafe personal factor was recorded.

Army Motor Vehicle Cases

A series of Innocent and Culpable distributions was prepared for seven variables for which data associated with Army motor vehicle accidents were available.

Age. Table 14 shows the relative age distribution for military and civilian drivers and for total military and civilian personnel for worldwide commands with the exception of Vietnam. Examination of these data indicates that Culpables are overrepresented in the age groups 15-19 and 20-24 and are underrepresented in all other age groups. The military driver contingent most dramatically accounts for this in both categories. The total military contingent also reflects this but not quite so markedly as drivers only.

Culpable civilian drivers, on the other hand, are most overrepresented in the 45-64 age category with lesser overrepresentation in 20-24, 15-19, and over 65 categories. The total civilian component shows approximately the same picture as the civilian drivers only. Unfortunately, a large proportion of both innocent and culpable civilian involvement records carried an "unknown" age code.

Assuming the validity of the innocent and culpable designations, remedial actions might best be aimed at somewhat different age groups for civilian and military personnel unless further investigation of the civilian unknown category greatly upsets the distributions shown.

Comparable data for Vietnam only are shown in Table 15. Examination of these data indicates that the respective age groups retain their relative rank-order in terms of overall involvement as compared with other worldwide data. There is a close concordance between the innocent and culpable distributions across the board. Regardless of whether military or civilian personnel are considered or whether drivers only or all personnel are considered, the culpable and innocent percentages are almost identical. Also, again there is a high proportion of civilian involvement record in which age was coded as unknown. Apparently a somewhat different set of age-related characteristics is involved in Vietnam and other worldwide experience.

Sex. Table 16 shows innocent and culpable distribution by sex both for worldwide data excluding Vietnam and for Vietnam data only. Interpretation of these data is a little ambiguous because of the relatively small number of female drivers, particularly in Vietnam, but overall, males are a little overrepresented in the culpable group and females are slightly underrepresented. This is reversed in the case of civilians in Vietnam, but the frequency base for these data is small as is the magnitude of the difference between innocent and culpable.

Grade. Table 17 shows innocent and culpable data in regard to the grade of the person involved. Considering all motor vehicle cases, enlisted grades, with the exception of the highest, are overrepresented in the culpable group, with commissioned officers and the highest ranking noncommissioned officers only slightly underrepresented. A similar type of situation occurs in that GS civilians are slightly underrepresented while WB civilians are somewhat overrepresented in the culpable group. This distribution is somewhat obscured, however, by the large number of civilian cases for which the Not Applicable code was used.

Examination of the data for the military drivers and for the total military contingent, indicates that overrepresentation in the culpable category applies only to the categories of Private, PFC, and SP4. Examination of the civilian distributions only indicates that the categories of WB civilians and other employees are the ones that are overrepresented in the culpable categories.

Table 18 shows comparable data for Vietnam only. Again, there are the close relationships between the innocent and culpable groups that are characteristic of the age variable. In this case, there is a slight overrepresentation of culpable military drivers at all ranks, except SP4, and variable representation by rank levels in terms of total military involvement. The differences, however, are extremely small.

Table 14

Involvement Comparisons for Army Motor Vehicle Accidents for Age for Worldwide Commands Excluding Vietnam

Age	Military Drivers		Total Military		Civilian Drivers		Total Civilians		All Motor Vehicle Cases	
	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable
0-4	0.0	0.0	0.0	0.0	0.2	0.1	1.0	0.7	0.4	0.2
5-14	0.0	0.0	0.0	0.0	0.2	0.2	3.0	2.6	1.1	0.6
15-19	12.5	19.5	14.3	19.8	2.2	4.2	3.6	4.3	9.6	15.7
20-24	55.8	63.1	58.1	63.1	7.5	9.9	7.7	10.0	36.2	47.9
25-44	23.4	14.8	20.3	14.6	32.7	32.7	32.5	32.9	24.6	18.6
45-64	2.1	0.8	1.6	0.8	13.7	17.2	14.2	17.0	6.5	4.5
65 and Over	0.0	0.0	0.0	0.0	0.8	1.4	0.9	1.4	0.4	0.4
Not Applicable	0.3	0.0	0.2	0.0	1.4	0.5	1.1	0.5	0.9	0.2
Unknown	6.0	1.7	5.4	1.8	41.3	33.8	36.2	30.7	20.3	10.0

Table 15

Involvement Comparisons for Army Motor Vehicle Accidents for Age for Vietnam Only

Age	Military Drivers		Total Military		Civilian Drivers		Total Civilians		All Motor Vehicle Cases	
	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable
0-4	0.0	0.0	0.0	0.0	0.0	0.0	1.6	2.0	0.4	0.4
5-14	0.0	0.1	0.0	0.1	0.0	1.5	7.1	13.3	1.7	3.3
15-19	14.0	16.7	13.0	16.5	2.7	6.5	9.5	6.5	11.5	13.2
20-24	62.9	63.0	61.4	62.4	1.8	6.0	2.4	3.9	43.5	45.4
25-44	14.5	12.8	14.2	13.2	37.2	35.0	32.5	29.2	18.3	16.4
45-64	0.6	0.5	0.7	0.5	8.0	7.5	9.1	7.5	2.8	2.0
65 and Over	0.0	0.0	0.0	0.0	0.0	2.5	2.0	2.3	0.7	0.5
Not Applicable	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unknown	8.1	6.9	10.7	7.3	50.4	41.0	35.7	35.4	21.2	18.8

Table 16

Involvement Comparisons for Army Motor Vehicle Accidents for Sex for All Commands

Age	Military Drivers		Total Military		Civilian Drivers		Total Civilians		All Motor Vehicle Cases	
	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable
Worldwide										
Male	99.6	99.8	99.5	99.7	89.3	91.7	84.2	90.2	92.8	97.2
Female	0.4	0.2	0.5	0.3	10.7	8.3	15.8	9.8	7.2	2.8
Vietnam										
Male	100.0	100.0	100.0	100.0	96.5	95.5	73.4	84.4	93.0	96.5
Female	0.0	0.0	0.0	0.0	3.5	4.5	26.6	15.6	7.0	3.5

Table 17

Involvement Comparisons for Army Motor Vehicle Accidents for Grade for Worldwide Commands Excluding Vietnam

Grade	Military Drivers		Total Military		Civilian Drivers		Total Civilians		All Motor Vehicle Cases	
	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable
Officers	5.7	2.4	5.1	2.3	0.0	0.0	0.0	0.0	3.0	1.8
Enlisted SP7 and Up	5.3	2.4	4.0	2.3	0.1	0.0	0.0	0.0	2.5	1.7
SSG	11.1	8.1	10.2	8.1	0.0	0.1	0.1	0.1	6.0	6.3
SP5	10.7	9.9	9.9	9.8	0.0	0.0	0.0	0.0	5.8	7.8
SP4	33.9	36.0	32.4	35.7	0.1	0.1	0.0	0.1	18.5	26.5
PFC	24.3	29.0	25.5	28.8	0.0	0.0	0.0	0.1	14.6	21.6
Private	6.2	11.3	10.4	12.0	0.0	0.0	0.0	0.0	5.9	8.9
Prisoner, Unknown	0.6	0.2	0.7	0.2	0.0	0.0	0.0	0.0	0.4	0.2
Civilians, GS	0.1	0.0	0.1	0.0	2.4	3.0	2.8	2.9	1.1	0.7
Civilians, WB	0.1	0.1	0.1	0.1	4.5	9.8	4.2	9.4	1.6	2.1
Other Employees	0.2	0.1	0.2	0.1	9.8	19.6	12.5	20.8	4.8	4.6
Other	1.0	0.3	0.8	0.4	0.1	0.2	0.2	0.3	0.5	0.4
Not Applicable	0.2	0.0	0.1	0.0	82.6	66.4	79.7	65.7	33.8	16.5
Unknown	0.6	0.1	0.5	0.1	0.6	0.8	0.5	0.8	1.5	1.0

Table 18

Involvement Comparisons for Army Motor Vehicle Accidents for Grade for Vietnam Only

Grade	Military Drivers		Total Military		Civilian Drivers		Total Civilians		All Motor Vehicle Cases	
	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable
Officers	2.2	3.0	2.4	2.8	0.0	0.0	0.0	0.0	1.7	1.9
Enlisted SP7 and Up	1.4	2.1	1.3	2.0	0.9	0.0	0.4	0.0	1.1	1.4
SSG	6.1	6.5	7.4	6.9	0.0	0.0	0.0	0.0	3.5	5.1
SP5	5.7	8.4	5.5	8.2	0.0	0.5	0.0	0.3	3.9	6.1
SP4	37.3	34.9	36.7	34.6	0.0	0.0	0.0	0.0	25.8	24.7
PFC	40.6	40.9	40.1	41.0	0.0	0.0	0.0	0.0	27.8	29.0
Private	2.4	3.7	2.3	3.3	0.0	0.0	0.0	0.0	1.6	2.6
Prisoner, Unknown	1.2	0.2	1.2	0.2	0.0	0.0	0.0	0.0	1.3	0.4
Civilians, GS	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.3	0.0	0.1
Civilians, WB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Employees	0.2	0.0	0.3	0.1	16.8	18.0	17.1	13.0	4.2	3.2
Other	1.0	0.0	0.7	0.1	0.0	0.0	0.0	0.3	0.5	0.3
Not Applicable	0.0	0.1	0.1	0.1	31.4	79.5	81.8	85.1	22.2	21.8
Unknown	1.8	0.4	2.0	0.5	0.9	1.5	0.8	1.0	4.8	3.5

Classification and Status of Personnel. Table 19 shows innocent and culpable distributions by the classification and status of the personnel involved. Examination of the data of all motor vehicle cases shows that all classes of military personnel, with the exception of Army Reservists and personnel from other military services, are overrepresented in the culpable category. Similarly, Army Civil Service civilians and Army contractor employees are somewhat overrepresented in the culpable category, while all other classes are underrepresented.

When military drivers only are considered, the categories of On Duty-Off Post and Off Duty-On Post are under- rather than overrepresented. When overall military are considered, Off Duty-Off Post also is underrepresented in the culpable group. When civilians only are considered (drivers only or all), Civil Service employees, Army contractor employees, and other employees on duty are overrepresented in the culpable categories.

Table 20 shows comparable data for Vietnam only. The data show the military category of On Duty-Off Post to be underrepresented in the culpable category; otherwise the same relationships found in worldwide data hold. The same holds true for military drivers only or all military personnel. Most of the civilian involvement is in the category of other civilians, and this category and Civil Service and Army contractor employees are overrepresented in the culpable category. Other Employees-On Duty, however, is underrepresented in the culpable category, contrary to findings for worldwide experience.

Hours On Duty. Table 21 shows the innocent and culpable distributions for the variable Hours on Duty. Throughout all categories of the data, the differences between innocent and culpable are very small. To attribute much credence to any of these differences doesn't seem warranted. The same may be said of the comparable Vietnam data that are shown in Table 22.

Training Status. Table 23 shows the innocent and culpable distribution for the variable Training Status for both worldwide excluding Vietnam and Vietnam alone. Because of the high Not Applicable coding frequency, no interpretation is warranted.

Activity At Time Of Accident. Table 24 shows innocent and culpable distributions for the variable Activity at Time of Accident. The largest difference between innocent and culpable when all motor vehicle cases are considered is found in the Wheeled Vehicle Underway categories all of which are overrepresented in the culpable category. This holds true for total military involvement and for all categories for military drivers except Underway Forward in which there is an underrepresentation. The relationships do hold true for civilians, both drivers and total.

Table 25 shows comparable data for Vietnam only. Overall, the Wheeled Underway categories are overrepresented in the culpable categories. Exceptions, however, are noted for both military and civilian drivers only, which are somewhat underrepresented in the culpable category for Underway Forward.

Other Accident Cases

Innocent and culpable distributions similar to those prepared for Army motor vehicle cases were also prepared for Other Accident cases. These are presented below. In these distributions, however, data are shown only for total military, total civilian, and total personnel categories.

Age. Table 26 shows the innocent and culpable age distributions for worldwide commands excluding Vietnam while Table 27 shows comparable data for Vietnam only. Ages 0-14 and 25-44 were underrepresented in the culpable group worldwide. The differences were not very large, however, and probably have little or no practical significance. These relationships were true for both civilian and military, except that the military group 45-64 was also underrepresented. In Vietnam, age groups 0-14 were underrepresented for both civilian and military; age groups 15-24 were overrepresented

Table 19

Involvement Comparisons for Army Motor Vehicle Accidents for Classification and Status for Worldwide Commands Excluding Vietnam

Classification and Status	Military Drivers		Total Military		Civilian Drivers		Total Civilians		All Motor Vehicle Cases	
	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable
Military										
On Duty-On Post	25.3	28.2	24.5	28.2	0.0	0.0	0.0	0.0	13.9	20.8
On Duty-Off Post	54.8	44.4	44.3	41.3	0.0	0.0	0.0	0.0	25.1	30.5
Off Duty-On Post	3.9	3.3	3.8	3.6	0.0	0.0	0.0	0.0	2.1	2.7
Off Duty-Off Post	6.2	8.6	9.3	9.2	0.0	0.0	0.0	0.0	5.3	6.8
On Leave-On Post	0.4	0.6	0.4	0.6	0.0	0.0	0.0	0.0	0.2	0.4
On Leave-Off Post	5.8	11.3	13.0	13.2	0.0	0.0	0.0	0.0	7.4	9.8
AWOL, TDY, Permanent Change of Station	1.8	3.1	3.0	3.4	0.0	0.0	0.0	0.0	1.7	2.5
Army Reserves	0.9	0.4	1.0	0.4	0.0	0.0	0.0	0.0	0.6	0.3
Other Services	1.1	0.2	0.8	0.3	0.0	0.0	0.0	0.0	0.4	0.2
Civilian										
Army Civil Service	0.0	0.0	0.0	0.0	7.0	12.8	7.0	12.2	2.5	2.6
Contractor Employees	0.0	0.0	0.0	0.0	1.2	4.2	1.5	4.6	0.6	1.0
Other Employees On Duty	0.0	0.0	0.0	0.0	8.3	15.7	11.2	16.3	4.1	3.5
Dependents	0.0	0.0	0.0	0.0	2.0	1.7	2.1	1.6	0.8	0.4
Other Civilian Personnel, n. e. c.	0.0	0.0	0.0	0.0	2.6	2.9	2.9	2.9	1.0	0.6
Other Civilians, n. e. c.	0.0	0.0	0.0	0.0	78.9	62.8	75.3	62.4	27.5	13.5
POWs and Foreign Nationals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.5
Not Applicable	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3	2.1
Unknown	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	1.0

Table 20

Involvement Comparisons for Army Motor Vehicle Accidents for Classification and Status for Vietnam Only

Classification and Status	Military Drivers		Total Military		Civilian Drivers		Total Civilians		All Motor Vehicle Cases	
	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable
Military										
On Duty-On Post	15.4	21.1	18.0	23.5	0.0	0.0	0.0	0.0	12.5	16.6
On Duty-Off Post	83.2	69.6	76.3	67.0	0.0	0.0	0.0	0.0	53.0	47.3
Off Duty-On Post	0.4	2.7	1.7	3.1	0.0	0.0	0.0	0.0	1.2	2.2
Off Duty-Off Post	0.4	4.9	2.6	4.7	0.0	0.0	0.0	0.0	1.8	3.3
On Leave-On Post	0.0	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.1
On Leave-Off Post	0.0	0.8	0.5	0.9	0.0	0.0	0.0	0.0	0.4	0.6
AWOL, TDY, Permanent Change of Station	0.0	0.7	0.4	0.6	0.0	0.0	0.0	0.0	0.3	0.4
Army Reserves	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Services	0.6	0.1	0.5	0.1	0.0	0.0	0.0	0.0	0.4	0.1
Civilian										
Army Civil Service	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.3	0.0	0.1
Contractor Employees	0.0	0.0	0.0	0.0	0.9	3.0	1.6	3.3	0.4	0.7
Other Employees on Duty	0.0	0.0	0.0	0.0	23.9	16.5	24.6	12.0	5.8	2.6
Dependents	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Civilian Personnel, n. e. c.	0.0	0.0	0.0	0.0	0.0	2.0	0.4	1.3	0.1	0.3
Other Civilians, n. e. c.	0.0	0.0	0.0	0.0	75.2	78.0	73.4	83.1	17.2	17.8
POWs and Foreign Nationals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	3.0
Not Applicable	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.6
Unknown	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	3.4

Table 21

Involvement Comparisons for Army Motor Vehicle Accidents for Hours on Duty for Worldwide Commands Excluding Vietnam

Hours on Duty	Military Drivers		Total Military		Civilian Drivers		Total Civilians		All Motor Vehicle Cases	
	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable
Less than 30 Min.	1.3	1.1	1.1	1.1	0.6	1.6	1.0	2.2	1.1	1.4
30 Min. but Less Than 1 Hour	2.7	2.2	2.1	2.0	1.1	2.3	1.5	2.4	1.8	2.1
1 Hr but < 2	7.1	6.7	5.9	6.3	2.3	4.1	2.8	4.3	4.4	5.7
2 Hrs but < 3	9.1	8.5	7.6	8.1	2.1	3.9	2.7	4.0	5.3	7.1
3 Hrs but < 4	7.4	7.3	6.7	7.0	1.4	3.3	1.5	3.4	4.4	6.1
4 Hrs but < 5	8.3	7.6	6.6	7.3	1.1	3.4	1.5	3.5	4.3	6.3
5 Hrs but < 6	7.3	6.1	6.0	5.7	1.2	2.6	1.4	2.7	4.0	4.9
6 Hrs but < 7	7.2	7.3	6.2	6.9	1.6	3.5	1.6	3.2	4.1	5.9
7 Hrs but < 8	7.3	6.0	6.1	5.7	1.4	3.1	1.5	2.8	4.0	4.9
8 Hrs but < 9	7.5	6.6	6.0	6.4	1.1	2.1	0.9	1.9	3.8	5.2
9 Hrs but < 10	3.5	3.3	3.0	3.1	0.3	0.6	0.4	0.5	1.9	2.4
10 Hrs but < 11	2.8	2.7	2.3	2.6	0.2	0.2	0.2	0.3	1.4	2.0
11 Hrs but < 12	1.6	1.5	1.9	1.4	0.1	0.3	0.1	0.2	1.1	1.1
12 Hrs but < 13	1.3	1.7	1.5	1.7	0.1	0.0	0.1	0.0	0.9	1.2
13 Hrs but < 14	0.6	0.8	0.7	0.7	0.1	0.2	0.0	0.1	0.4	0.6
14 Hrs but < 15	1.2	0.8	1.0	0.8	0.1	0.0	0.1	0.0	0.6	0.6
15 Hrs but < 16	0.5	0.4	0.3	0.5	0.0	0.0	0.0	0.0	0.2	0.4
16 Hrs but < 17	0.5	0.5	0.5	0.5	0.0	0.0	0.0	0.0	0.3	0.4
17 Hrs but < 19	0.3	0.5	0.5	0.5	0.0	0.0	0.0	0.0	0.3	0.4
19 Hrs but < 21	0.2	0.3	0.2	0.3	0.0	0.0	0.0	0.0	0.1	0.2
21 Hrs but < 24	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.2	0.2
24 Hrs but < 30	0.1	0.2	0.1	0.2	0.0	0.0	0.0	0.0	0.1	0.2
30 Hrs but < 36	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36 Hrs and Over	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1
Not Applicable	18.4	26.3	30.0	29.4	83.1	66.9	80.1	66.1	51.2	38.5
Unknown	3.7	1.4	3.4	1.3	2.0	1.8	2.6	2.2	4.4	2.4

Table 22

Involvement Comparisons for Army Motor Vehicle Accidents for Hours on Duty for Vietnam Only

Hours on Duty	Military Drivers		Total Military		Civilian Drivers		Total Civilians		All Motor Vehicle Cases	
	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable
Less than 30 Min.	0.8	1.2	0.8	1.3	0.0	1.0	0.0	0.7	0.6	1.1
30 Min. but Less Than 1 Hour	1.6	1.4	1.5	1.6	0.0	0.5	0.0	0.3	1.1	2.1
1 Hr but < 2	6.9	6.2	5.8	6.4	3.5	1.5	3.2	1.3	4.8	4.8
2 Hrs but < 3	11.0	8.6	11.5	8.4	1.8	1.5	2.4	1.3	8.6	6.2
3 Hrs but < 4	7.1	8.3	6.2	8.5	1.8	1.5	1.6	1.0	4.7	6.2
4 Hrs but < 5	12.2	6.9	10.3	7.1	1.8	2.5	1.2	1.6	7.6	5.4
5 Hrs but < 6	9.7	7.0	9.8	6.9	3.6	1.5	2.8	1.3	7.4	5.1
6 Hrs but < 7	5.3	9.3	6.7	8.8	0.0	1.0	0.0	1.0	4.7	6.4
7 Hrs but < 8	7.5	7.1	6.8	7.2	1.8	0.5	1.2	0.7	5.0	5.2
8 Hrs but < 9	10.8	8.6	9.1	8.9	0.0	1.0	0.0	0.7	6.3	6.4
9 Hrs but < 10	5.1	5.4	5.4	5.2	0.0	0.0	0.0	0.0	3.7	3.7
10 Hrs but < 11	4.5	5.3	4.0	5.1	0.9	0.0	1.2	0.0	3.1	3.7
11 Hrs but < 12	3.5	2.9	2.7	2.7	0.0	1.0	0.0	0.7	1.9	2.0
12 Hrs but < 13	2.2	1.9	3.1	2.2	0.9	0.5	0.4	0.3	2.2	1.6
13 Hrs but < 14	0.4	0.9	0.3	0.8	0.0	0.0	0.0	0.0	0.2	0.6
14 Hrs but < 15	1.4	0.8	0.9	0.7	0.9	0.0	0.4	0.0	0.7	0.5
15 Hrs but < 16	0.4	0.5	0.3	0.6	0.0	0.5	0.0	0.3	0.3	0.5
16 Hrs but < 17	1.0	0.7	0.9	0.7	0.0	0.0	0.0	0.0	0.7	0.5
17 Hrs but < 19	0.2	0.8	0.3	0.8	0.0	0.0	0.0	0.0	0.2	0.6
19 Hrs but < 21	0.2	0.4	0.1	0.4	0.0	0.0	0.0	0.0	0.1	0.3
21 Hrs but < 24	0.2	0.7	0.1	0.6	0.9	0.0	0.4	0.0	0.2	0.4
24 Hrs but < 30	0.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0
30 Hrs but < 36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36 Hrs and Over	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Not Applicable	0.8	8.8	5.2	9.1	74.3	79.0	77.8	83.4	24.7	27.6
Unknown	7.1	6.5	8.0	6.4	8.0	6.5	7.5	5.5	11.4	10.3

Table 23

Involvement Comparisons for Army Motor Vehicle Accidents for All Commands

Training Status	Military Drivers		Total Military		Civilian Drivers		Total Civilians		All Motor Vehicle Cases	
	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable
Worldwide										
Initial Training	0.6	1.1	1.0	1.2	0.0	0.1	0.0	0.1	0.6	0.9
Installation Directed	2.1	3.9	3.7	4.1	0.1	0.1	0.1	0.1	2.1	3.0
Command Directed	0.9	1.4	1.2	1.4	0.0	0.0	0.0	0.0	0.7	1.0
All Other	2.6	2.4	2.8	2.5	0.1	0.3	0.1	0.3	1.7	2.0
Not Applicable	93.8	91.1	91.4	90.9	99.7	99.6	99.8	99.5	94.9	93.0
Vietnam										
Initial Training	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Installation Directed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Command Directed	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1
All Other	0.2	0.4	0.1	0.4	0.0	0.0	0.0	0.0	0.1	0.3
Not Applicable	99.8	99.5	99.9	99.5	100.0	100.0	100.0	100.0	100.0	99.7

Table 24

Involvement Comparisons for Army Motor Vehicle Accidents for Activity at Time of Accident for Worldwide Commands Excluding Vietnam

Activity at Time of Accident	Military Drivers		Total Military		Civilian Drivers		Total Civilians		All Motor Vehicle Cases	
	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable
Non-Official Administration	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
Training	0.0	0.0	0.5	0.3	0.0	0.0	0.0	0.0	0.3	0.2
Supply	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.3	0.1	0.1
Watercraft	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.0
Railway	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wheeled Vehicle Load/Unload	0.0	0.0	0.5	0.3	0.0	0.0	0.1	0.1	0.4	0.3
Wheeled Vehicle Entering/Departing	0.6	1.4	0.3	1.3	0.3	1.1	0.2	1.0	0.3	1.1
Wheeled Vehicle Underway Forward	62.5	61.4	33.0	45.3	13.2	20.4	9.8	17.3	22.7	38.5
Underway Backing	0.9	7.9	0.5	7.0	0.2	4.6	0.2	3.9	0.4	6.0
Underway Turning	7.4	12.5	3.9	11.0	1.2	4.9	0.9	4.1	2.5	9.2
Passenger Riding	0.0	0.0	13.9	1.2	0.0	0.0	4.5	0.6	9.7	1.1
Passenger Embark/Debark	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.2	0.1	0.2
Other Army Wheeled Vehicle	0.0	0.0	7.6	2.0	0.0	0.0	1.5	1.0	5.1	1.7
Tracked Vehicle Weapon Ops	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tracked Vehicle Driver or Crew Load/Unload	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tracked Vehicle Underway Forward	1.3	1.4	0.7	1.3	0.0	0.0	0.1	0.2	0.4	1.0
Underway Backing	0.1	0.2	0.1	0.2	0.0	0.2	0.0	0.1	0.0	0.2

(Continued)

Table 24 *(Continued)*

Involvement Comparisons for Army Motor Vehicle Accidents for Activity at Time of Accident for Worldwide Commands Excluding Vietnam

Activity at Time of Accident	Military Drivers		Total Military		Civilian Drivers		Total Civilians		All Motor Vehicle Cases	
	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable
Tracked Vehicle *(Continued)*										
Underway Turning	0.1	0.5	0.0	0.4	0.1	0.1	0.0	0.1	0.0	0.3
Passenger	0.0	0.0	0.9	0.3	0.0	0.1	0.0	0.0	0.5	0.2
Other	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.1	0.1	0.1
Government Non-Army Vehicle	0.0	0.0	0.1	0.1	0.0	0.0	1.7	2.0	0.7	0.5
Commercial	0.0	0.0	0.4	0.0	0.0	0.0	2.4	1.9	1.1	0.4
Private Auto										
Driver	23.9	21.1	12.6	18.6	81.7	0.0	60.5	54.1	33.2	27.6
Passenger	0.0	0.0	17.0	4.4	0.0	63.8	7.8	1.0	12.8	3.5
Private Cycle										
Driver	3.2	3.6	1.7	3.2	3.2	0.0	2.4	4.2	1.9	3.5
Passenger	0.0	0.0	0.8	0.3	0.0	4.9	1.5	0.3	1.1	0.3
Other Conveyance	0.0	0.0	0.2	0.1	0.0	0.0	0.5	0.6	0.4	0.3
Maintenance and Repair	0.0	0.0	0.8	0.3	0.0	0.0	0.3	0.3	0.6	0.3
Servicing	0.0	0.0	0.4	0.4	0.0	0.0	0.1	0.4	0.3	0.4
Sports and Recreational Activity	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
Other	0.0	0.0	1.9	1.5	0.0	0.0	3.1	5.0	2.4	2.3
Not Applicable	0.0	0.0	0.4	0.1	0.0	0.0	2.1	1.2	2.2	0.4
Unknown	0.0	0.0	0.3	0.1	0.0	0.0	0.2	0.1	0.4	0.2

Table 25

Involvement Comparisons for Army Motor Vehicle Accidents for Activity at Time of Accident for Vietnam Only

Activity Time of Accident	Military Drivers		Total Military		Civilian Drivers		Total Civilians		All Motor Vehicle Cases	
	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable
Non-Official Administration	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Training	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Supply	0.0	0.0	0.4	0.2	0.0	0.0	0.4	0.3	0.4	0.2
Watercraft	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.3	0.0
Railway	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wheeled Vehicle Load/Unload	0.0	0.0	1.9	0.4	0.0	0.0	0.4	0.0	1.7	0.3
Wheeled Vehicle Entering/Departing	0.4	0.0	0.3	0.0	0.9	0.0	0.4	0.0	0.3	0.0
Wheeled Vehicle Underway Forward	92.3	86.2	61.0	78.8	21.2	15.0	9.5	9.8	46.2	60.7
Underway Backing	1.6	6.5	1.1	5.9	1.8	1.5	0.8	1.0	1.0	4.7
Underway Turning	4.3	4.0	2.8	3.6	0.0	1.5	0.0	1.0	2.0	2.8
Passenger Riding	0.0	0.0	16.5	1.7	0.0	0.0	11.9	0.0	14.4	1.5
Passenger Embark/Debark	0.0	0.0	0.0	0.3	0.0	0.0	0.0	1.0	0.0	0.4
Other Army Wheeled Vehicle	0.0	0.0	8.9	2.7	0.0	0.0	1.2	0.3	7.7	2.2
Tracked Vehicle Weapon Ops	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tracked Vehicle Driver or Crew Load/Unload	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tracked Vehicle Underway Forward	0.4	1.1	0.3	1.0	0.0	0.0	0.0	0.0	0.2	0.7
Underway Backing	0.0	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.1

(Continued)

Table 25 *(Continued)*

Involvement Comparisons for Army Motor Vehicle Accidents for Activity at Time of Accident for Vietnam Only

Activity at Time of Accident	Military Drivers		Total Military		Civilian Drivers		Total Civilians		All Motor Vehicle Cases	
	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable
Tracked Vehicle *(Continued)*										
Underway Turning	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Passenger	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Government Non-Army Vehicle	0.0	0.0	0.3	0.2	0.0	0.0	0.0	0.0	0.3	0.4
Commercial	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.7	0.2	0.1
Private Auto										
Driver	0.4	0.2	0.3	1.7	44.3	32.0	19.8	20.8	5.6	5.6
Passenger	0.0	0.0	0.3	0.1	0.0	0.0	7.5	4.6	2.4	1.0
Private Cycle										
Driver	0.6	1.8	0.4	1.7	31.9	50.0	14.3	32.5	3.8	9.7
Passenger	0.0	0.0	1.1	0.1	0.0	0.0	16.3	2.3	5.0	0.6
Other Conveyance	0.0	0.0	0.3	0.1	0.0	0.0	0.8	1.3	1.1	1.0
Maintenance and Repair	0.0	0.0	0.7	0.8	0.0	0.0	0.4	0.0	0.6	0.6
Servicing	0.0	0.0	0.1	0.2	0.0	0.0	0.8	0.0	0.3	0.1
Sports and Recreational Activity	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other	0.0	0.0	2.8	2.0	0.0	0.0	14.3	24.4	5.9	7.1
Not Applicable	0.0	0.0	0.3	0.0	0.0	0.0	0.4	0.0	0.5	0.1
Unknown	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.3	0.3	0.1

Table 26

Involvement Comparisons for Other Accidents for Age for Worldwide Commands Excluding Vietnam

Age	Total Military		Total Civilian		Total Other	
	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable
0-4	0.1	0.0	0.5	0.1	0.2	0.0
5-14	0.1	0.0	1.5	0.3	0.4	0.1
15-19	18.6	23.0	4.1	4.9	14.9	18.4
20-24	53.9	56.5	7.3	9.1	42.1	44.7
25-44	23.4	17.6	44.3	41.7	28.4	23.4
45-64	1.5	1.1	31.0	37.9	8.7	10.0
65 and Over	0.0	0.0	1.0	2.2	0.3	0.5
Not Applicable	0.1	0.0	0.7	0.1	0.3	0.1
Unknown	2.5	1.8	9.6	3.8	4.8	2.7

Table 27

Involvement Comparisons for Other Accidents for Age for Vietnam Only

Age	Total Military		Total Civilian		Total Other	
	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable
0-4	0.0	0.0	1.4	0.0	0.2	0.0
5-14	0.0	0.1	11.1	2.1	1.8	0.1
15-19	11.8	13.1	8.3	14.9	11.1	12.8
20-24	56.2	61.4	5.6	8.5	47.5	58.3
25-44	24.1	17.5	26.4	34.0	24.2	18.0
45-64	0.8	0.7	11.1	12.8	2.4	1.1
65 and Over	0.0	0.0	1.4	4.3	0.2	0.1
Not Applicable	0.0	0.0	0.0	0.0	0.0	0.0
Unknown	7.2	7.3	34.7	23.4	12.7	9.5

for both military and civilian, and age groups 25-65 and over were overrepresented for civilians but under or equally represented for military personnel. The largest discrepancies occurred in the 20-44 age range.

Sex. Table 28 shows the variable Sex distributions for both worldwide commands and Vietnam only. In both cases, the males are overrepresented in the culpable group and the females underrepresented. Most of this is accounted for by the civilian personnel contingent since there are apparently so few female military personnel involved.

Grade. Table 29 shows the worldwide command distributions for innocent and culpable groups for the variable Grade. All military grades above the rank of PFC were somewhat underrepresented in the culpable group while PFC and Private were overrepresented. In the civilian component, it was the Wage Board and other employees that were overrepresented, while the GS employees were somewhat underrepresented.

Table 28

Involvement Comparisons for Other Accidents for Sex for All Commands

Sex	Total Military		Total Civilian		Total Other	
	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable
Worldwide						
Male	99.3	99.5	77.8	86.3	94.1	96.3
Female	0.7	0.5	22.2	13.7	5.9	3.7
Vietnam						
Male	100.0	99.9	47.2	89.4	91.6	99.6
Female	0.0	0.7	52.8	10.6	8.4	0.4

Table 29

Involvement Comparisons for Other Accidents for Grade for Worldwide Commands Excluding Vietnam

Grade	Total Military		Total Civilian		Total Other	
	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable
Officers	13.4	7.1	0.2	0.0	10.1	5.3
Enlisted SP7 and Up	3.9	2.9	0.0	0.0	2.9	2.1
SSG	9.5	7.5	0.0	0.0	7.0	5.7
SP5	7.1	6.4	0.2	0.0	5.6	4.9
SP4	21.3	19.3	0.2	0.0	15.9	14.4
PFC	23.5	24.1	0.0	0.0	17.5	18.1
Private	20.4	31.8	0.0	0.0	15.2	23.8
Prisoner, Unknown	0.1	0.2	0.0	0.0	0.1	0.2
Civilians, GS	0.0	0.0	9.6	7.0	2.4	1.7
Civilians, WB	0.1	0.1	18.1	23.4	4.5	5.7
Other Employees	0.1	0.1	53.1	62.3	13.1	15.2
Other	0.4	0.3	0.0	0.0	0.3	0.2
Not Applicable	0.0	0.0	17.4	6.8	4.9	1.9
Unknown	0.4	0.3	1.2	0.6	0.7	0.7

Table 30 shows comparable data for Vietnam only. The results are similar except that here in this military contingent the overrepresentation goes up two grades. In the civilian contingent the big difference is in the Other Employees category which is grossly overrepresented in the culpable group.

Classification and Status. Table 31 shows the innocent and culpable data for the variable Classification and Status for worldwide commands excluding Vietnam. With the exception of On Duty-Off Post, TDY, Reservists and other service personnel, all military classifications are overrepresented in the culpable group. For the civilian component, Other Employees-On Duty category is grossly overrepresented and Civil Service personnel are somewhat overrepresented while all others are somewhat underrepresented.

Table 30

Involvement Comparisons for Other Accidents for Grade for Vietnam Only

Grade	Total Military		Total Civilian		Total Other	
	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable
Officers	11.2	7.6	0.0	0.0	9.3	7.1
Enlisted SP7 and Up	2.7	1.3	0.0	0.0	2.2	1.3
SSG	12.3	7.8	0.0	0.0	10.2	7.4
SP5	6.2	6.8	0.0	0.0	5.3	6.4
SP4	22.7	26.6	0.0	0.0	18.9	25.1
PFC	40.1	44.7	0.0	0.0	33.3	42.3
Private	2.7	3.9	0.0	0.0	2.2	3.7
Prisoner, Unknown	0.0	0.4	0.0	0.0	0.0	0.8
Civilians, GS	0.0	0.0	1.4	2.1	0.2	0.1
Civilians, WB	0.0	0.0	0.0	0.0	0.0	0.0
Other Employees	0.0	0.2	43.1	63.8	6.9	2.4
Other	0.5	0.1	0.0	0.0	0.4	0.1
Not Applicable	0.0	0.0	55.6	34.0	9.5	1.5
Unknown	1.6	0.6	0.0	0.0	1.6	1.8

Table 32 shows comparable data for Vietnam only. The results are similar. In the military, however, the On Leave categories are no longer overrepresented in the culpable group. In the civilian contingent, Army contractor employees category joins Civil Service and Other Employees-On Duty categories in the overrepresented class. The largest discrepancy is again in the category of Other Employees-On Duty.

Hours On Duty. Tables 33 and 34 present the data for the variable Hours on Duty for worldwide commands and Vietnam only, respectively. With the exception of three Time categories for the civilian contingent in Vietnam, in which there is noticeable overrepresentation in the culpable group, the differences between Innocents and Culpables are very small and of no consequence.

Training Status. The data for the variable Training Status for both worldwide commands and Vietnam only are shown in Table 35. The differences between Innocents and Culpables are very small and because of the large frequency in the Not Applicable code, no further interpretation seems warranted.

Activity At Time Of Accident. Table 36 presents the worldwide command data for the variable Activity at Time of Accident. In most cases the differences between Innocents and Culpables are relatively small. The biggest difference occurs with Wheeled Vehicle involvement and in all cases there is an underrepresentation of Culpables. The Transportation and Administrative activities generally showed small underrepresentation, while others, particularly Maintenance and Repair, Servicing, and Unsupervised Recreation, generally were overrepresented in the culpable group.

Table 37 shows comparable data for Vietnam and the results are basically very similar.

Table 31

Involvement Comparisons for Other Accidents for Classification and Status for Worldwide Commands Excluding Vietnam

Classification and Status	Total Military		Total Civilian		Total Other	
	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable
Military						
On Duty-On Post	54.1	55.1	0.0	0.0	40.1	41.2
On Duty-Off Post	19.1	7.3	0.0	0.0	14.1	5.5
Off Duty-On Post	12.6	20.6	0.0	0.0	9.4	15.4
Off Duty-Off Post	4.6	6.0	0.0	0.0	3.4	4.5
On Leave-On Post	0.1	1.2	0.0	0.0	0.5	0.9
On Leave-Off Post	2.9	7.0	0.0	0.0	2.1	5.2
AWOL, TDY, Permanent Change of Station	1.9	1.7	0.0	0.0	1.4	1.3
Army Reserves	3.9	0.8	0.0	0.0	2.9	0.6
Other Services	0.3	0.3	0.0	0.0	0.3	0.2
Civilian						
Army Civil Service	0.0	0.0	28.4	30.4	7.0	7.4
Contractor Employees	0.0	0.0	25.6	19.7	6.3	4.8
Other Employees On Duty	0.0	0.0	28.8	43.4	7.1	10.5
Dependents	0.0	0.0	1.0	0.9	0.3	0.2
Other Civilian Personnel, n. e. c.	0.0	0.0	0.0	0.5	0.2	0.1
Other Civilians, n. e. c.	0.0	0.0	15.4	5.1	3.8	1.2
FOWs and Foreign Nationals	0.0	0.0	0.0	0.0	0.5	0.5
Not Applicable	0.0	0.0	0.0	0.0	0.4	0.2
Unknown	0.0	0.0	0.0	0.0	0.4	0.4

Table 32

Involvement Comparisons for Other Accidents for Classification and Status for Vietnam Only

Classification and Status	Total Military		Total Civilian		Total Other	
	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable
Military						
On Duty-On Post	58.0	63.2	0.0	0.0	48.1	59.6
On Duty-Off Post	29.7	23.8	0.0	0.0	24.6	22.5
Off Duty-On Post	9.1	9.6	0.0	0.0	7.5	9.1
Off Duty-Off Post	1.9	2.4	0.0	0.0	1.6	2.2
On Leave-On Post	0.3	0.0	0.0	0.0	0.2	0.0
On Leave-Off Post	0.3	0.3	0.0	0.0	0.2	0.3
AWOL, TDY, Permanent Change of Station	0.8	0.7	0.0	0.0	0.7	0.6
Army Reserves	0.0	0.0	0.0	0.0	0.0	0.0
Other Services	0.0	0.0	0.0	0.0	0.0	0.0
Civilian						
Army Civil Service	0.0	0.0	1.4	2.1	0.2	0.1
Contractor Employees	0.0	0.0	2.8	4.3	0.4	0.1
Other Employees On Duty	0.0	0.0	45.8	76.6	7.3	2.5
Dependents	0.0	0.0	0.0	0.0	0.0	0.0
Other Civilian Personnel, n. e. c.	0.0	0.0	0.0	0.0	[illegible]	[illegible]
Other Civilians, n. e. c.	0.0	0.0	50.0	17.0	8.0	0.6
POWs and Foreign Nationals	0.0	0.0	0.0	0.0	0.7	0.4
Not Applicable	0.0	0.0	0.0	0.0	0.0	0.0
Unknown	0.0	0.0	0.0	0.0	0.4	2.0

Table 33

Involvement Comparisons for Other Accidents for Hours on Duty for Worldwide Commands Excluding Vietnam

Hours on Duty	Total Military		Total Civilian		Total Other	
	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable
Less than 30 Min.	1.2	1.0	3.1	4.0	1.7	1.7
30 Minutes but Less than 1 Hour	1.4	1.7	4.9	5.1	2.2	2.5
1 Hr but < 2	6.3	5.5	9.1	12.2	7.1	7.1
2 Hrs but < 3	8.1	6.7	12.9	14.3	9.1	8.5
3 Hrs but < 4	6.6	6.7	10.2	13.6	7.4	8.3
4 Hrs but < 5	8.8	6.7	8.1	8.9	8.5	7.2
5 Hrs but < 6	4.9	4.7	8.8	6.6	5.8	5.1
6 Hrs but < 7	7.6	5.3	10.2	10.9	8.2	6.6
7 Hrs but < 8	5.2	5.0	8.3	9.6	6.0	6.1
8 Hrs but < 9	8.5	6.1	3.4	4.1	7.1	5.6
9 Hrs but < 10	3.0	2.6	0.9	1.0	2.4	2.2
10 Hrs but < 11	3.0	2.7	0.7	0.4	2.4	2.1
11 Hrs but < 12	1.9	1.4	0.2	0.3	1.5	1.2
12 Hrs but < 13	3.2	2.1	0.2	0.1	2.4	1.6
13 Hrs but < 14	1.0	0.9	0.0	0.2	0.7	0.7
14 Hrs but < 15	1.0	0.9	0.0	0.0	0.7	0.7
15 Hrs but < 16	1.1	0.6	0.0	0.0	0.8	0.4
16 Hrs but < 17	0.6	0.5	0.0	0.0	0.5	0.4
17 Hrs but < 19	0.8	0.4	0.0	0.0	0.6	0.3
19 Hrs but < 21	0.6	0.2	0.0	0.1	0.5	0.2
21 Hrs but < 24	0.3	0.2	0.2	0.2	0.3	0.2
24 Hrs but < 30	0.3	0.3	0.0	0.0	0.2	0.2
30 Hrs but < 36	0.1	0.1	0.0	0.0	0.1	0.0
36 Hrs and Over	0.2	0.2	0.0	0.0	0.1	0.2
Not Applicable	22.7	36.7	17.9	7.0	22.0	29.5
Unknown	1.8	1.0	1.2	1.5	1.7	1.4

Table 34

Involvement Comparisons for Other Accidents for Hours on Duty for Vietnam Only

Hours on Duty	Total Military		Total Civilian		Total Other	
	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable
Less than 30 Min.	1.1	1.9	1.4	2.1	1.1	1.9
30 Min. but Less than 1 Hour	0.8	2.6	0.0	4.3	0.7	2.6
1 Hr but < 2	9.4	9.1	2.8	6.4	8.2	8.8
2 Hrs but < 3	9.6	7.8	4.2	14.9	8.7	7.8
3 Hrs but < 4	7.5	9.1	5.6	14.9	7.1	9.5
4 Hrs but < 5	10.7	10.2	4.2	6.4	9.5	9.8
5 Hrs but < 6	4.8	5.0	0.0	0.0	4.0	4.8
6 Hrs but < 7	5.6	6.2	29.4	6.4	8.9	6.0
7 Hrs but < 8	4.8	6.8	1.4	2.1	4.2	6.5
8 Hrs but < 9	11.8	7.6	2.8	2.1	3.8	7.4
9 Hrs but < 10	5.1	3.5	0.0	2.1	2.2	3.4
10 Hrs but < 11	4.3	5.0	1.4	4.3	3.8	4.9
11 Hrs but < 12	2.7	2.5	0.0	0.0	2.2	2.3
12 Hrs but < 13	3.7	3.3	0.0	0.0	3.0	3.1
13 Hrs but < 14	0.5	0.7	0.0	2.1	0.4	0.7
14 Hrs but < 15	0.3	1.1	0.0	0.0	0.2	1.1
15 Hrs but < 16	0.8	0.6	0.0	0.0	0.7	0.6
16 Hrs but < 17	0.3	0.5	0.0	0.0	0.2	0.4
17 Hrs but < 19	0.3	0.2	0.0	0.0	0.2	0.1
19 Hrs but < 21	0.0	0.2	0.0	0.0	0.0	0.1
21 Hrs but < 24	0.3	0.1	0.0	0.0	0.2	0.1
24 Hrs but < 30	0.3	0.5	0.0	0.0	0.2	0.5
30 Hrs but < 36	0.3	0.0	0.0	0.0	0.2	0.0
36 Hrs and Over	0.0	0.0	0.0	0.0	0.0	0.0
Not Applicable	11.8	12.5	50.0	19.2	18.4	12.8
Unknown	3.5	2.9	0.0	12.8	3.3	5.0

Table 35

Involvement Comparisons for Other Accidents for Training and Status for All Commands

Training Status	Total Military		Total Civilian		Total Other	
	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable
WORLDWIDE						
Initial Training	16.5	16.7	0.0	0.3	12.3	12.6
Installation Directed	5.1	6.4	0.0	0.1	3.9	4.8
Command Directed	1.3	1.1	0.0	0.0	1.0	0.9
All Other	8.5	4.7	0.7	0.1	6.6	3.8
Not Applicable	68.6	71.1	99.3	98.7	76.2	77.9
VIETNAM						
Initial Training	0.0	0.2	0.0	0.0	0.0	0.1
Installation Directed	0.0	0.0	0.0	0.0	0.0	0.0
Command Directed	1.1	0.1	0.0	0.0	0.9	0.1
All Other	1.1	0.8	0.0	0.0	0.9	0.8
Not Applicable	97.9	99.0	100.0	100.0	98.2	99.0

Table 36

Involvement Comparisons for Other Accidents for Activity at Time of Accident for Worldwide Commands Excluding Vietnam

Activity at Time of Accident	Total Military		Total Civilian		Total Other	
	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable
Administrative	0.6	0.3	5.4	3.8	1.8	1.4
Development Army Supv.	25.1	26.5	1.0	0.8	19.0	20.1
Supply	4.2	4.1	22.5	27.5	8.7	9.7
Army Transportation						
Watercraft	0.8	0.3	0.5	0.3	0.7	0.3
Railway	0.0	0.1	1.5	0.6	0.4	0.2
Wheeled Vehicle	13.5	3.2	13.0	3.4	13.4	3.4
Tracked Vehicle	3.2	1.4	0.0	0.3	2.4	1.2
Aircraft	7.8	2.4	2.9	0.8	6.6	2.0
Other Transportation	2.5	1.2	10.5	5.1	4.7	2.4
Maintenance and Repair	3.5	6.8	11.0	21.7	5.4	10.4
Servicing	5.2	7.1	7.8	18.7	5.8	9.9
Recreational not Army Supv.	7.4	10.3	0.0	0.2	5.6	7.7
Other, n.e.c.	25.1	35.9	21.7	16.3	24.1	31.0
Not Applicable	1.0	0.2	2.0	0.4	1.3	0.3
Unknown	0.2	0.3	0.2	0.2	0.2	0.4

Table 37

Involvement Comparisons for Other Accidents for Activity at Time of Accident for Vietnam Only

Activity at Time of Accident	Total Military		Total Civilian		Total Other	
	Innocent	Culpable	Innocent	Culpable	Innocent	Culpable
Administrative	0.3	0.1	0.0	0.0	0.2	0.1
Development, Army Supv.	0.8	2.4	0.0	0.0	0.7	2.2
Supply	12.8	16.3	5.6	34.0	11.8	16.7
Army Transportation						
Watercraft	3.0	1.8	4.2	4.3	3.1	1.8
Railway	0.0	0.0	0.0	0.0	0.0	0.0
Wheeled Vehicle	9.9	8.8	6.9	8.5	9.3	9.2
Tracked Vehicle	2.7	2.2	0.0	0.0	2.2	2.2
Aircraft	7.8	5.3	0.0	0.0	6.4	5.1
Other Transportation	1.6	1.0	16.7	8.5	4.2	1.5
Maintenance and Repair	5.1	11.1	1.4	6.4	4.4	10.6
Servicing	8.6	13.0	0.4	12.8	7.5	12.7
Recreational, not Army Supv.	0.8	1.7	0.0	0.0	0.7	1.6
Other, n.e.c.	46.8	36.1	62.5	25.5	49.2	35.7
Not Applicable	0.0	0.1	1.4	0.0	0.2	0.1
Unknown	0.0	0.4	0.0	0.0	0.0	0.5

Summary Of Indirect Exposure Comparisons

With the data available to the AIR staff during the project, there was no direct way in which the validity of the indirect exposure concept utilizing Innocents and Culpables could be checked in a definitive manner. If the basic hypothesis is accepted, what conclusions can be drawn? Since unsafe acts or unsafe personnel factors were used to define the Innocent group, only those characteristics that were somehow directly relatable to personnel could justifiably be used in this type of analysis. This is, of course, an obvious limitation of this method. Even when personnel-related variables were examined, the conclusions that can be drawn are limited. The method focuses attention on various groups within a single variable, but contributes nothing toward an understanding of why the situation may exist. More often than not, data from outside the present error counting system—in terms of either personal characteristics, equipment or facility usage, or general environmental conditions—would be necessary to begin to understand the why. The kind of information most needed is not routinely kept in comparable fashion within different organizational units. Accepting the fundamental validity of the assumption underlying the method, it identifies relatively specific areas for further study but does not directly provide the means for deeper probing.

In terms of the specific data presented, most coding categories showed only slight differences between Innocents, which is supposed to equal exposure, and Culpables. It appears, therefore, that for most subgroups within the variables studied, accidents were being experienced roughly in proportion to exposure. This again provides little guidance for specific remedial programs designed to reduce either the frequency or the severity of accidents.

REVIEW OF FREQUENCY DATA

Many of the 28 basic variables studied have been previously discussed either in connection with inter-unit comparisons or indirect measures of exposure. For other variables, only the raw and percentage frequency data were recomputed according to the newly requested groupings and definitions. These are briefly discussed here. The detailed data were submitted separately as computer printouts and are not repeated in this report. These discussions are oriented toward separate variables, each of which is discussed in terms of Army Motor Vehicle, Private Motor Vehicle, and Other Accident categories.

Hour of Day

The afternoon hours between 1400-1600 were the worst for Army motor vehicle accidents and other accidents. Private motor vehicle accidents, however, peaked in the late night and early morning hours, particularly if the spotty Vietnam data are ignored. Early morning hours are the safest except for the previously mentioned private auto accidents. Exposure data are not available to help interpret these findings.

Day of Week

The daily pattern shifts considerably depending upon the type of accidents considered. Army motor vehicle accidents and other accidents tend to peak on different week days. Private motor vehicle accidents have more of a tendency to peak on weekend days. If all days were equally represented, each would have about 14%. Army motor vehicle accidents ranged from 6% to 18%; private motor vehicles from 0% to 32%; and other accidents between 10% and 17%. The least daily variation was for other accidents, and the most variation for private motor vehicle accidents.

Day of Month

These data show only a small variation in percentages from one day to the next with the exception of private motor vehicle accidents in Vietnam. The frequencies for this command are so small, however, that only small absolute differences appear in magnified form when treated as a percentage. One calendar day is about as good or as bad as the next.

Month

Frequencies by month are not very enlightening either. With the exception of Vietnam, where again the size of the frequencies distorts the percentage distribution, the range from month to month is not great.

Classification of Accident

In the case of Army motor vehicle accidents, the involvement is basically divided between Army operated vehicles and a combination of Army operated and non-Army operated vehicles. Worldwide the split is about equal, while in Vietnam it is about three to one in favor of Army operated vehicles. Contractor operated is an insignificant factor. By definition, all of the private motor vehicle accidents concerned non-Army operated equipment. In the case of other accidents in which different categories were used to define classification, the undifferentiated Other category drew the highest frequencies. Worldwide, this was followed by Training and then Recreation. In Vietnam, the Other category was followed by Weapons Firing and Materials Handling. Differences in mission emphasis probably account for these results. In all cases, Manufacturing and Marine

Operations were uniformly low. These probably reflect differences in relative exposure more than anything else.

Ownership

This variable sheds little light since, with the exception of private motor vehicle accidents, the ownership is almost entirely Army with only an insignificant amount accounted for by Army non-appropriated funds. Army contractor ownership plays a part in the private motor vehicle accidents especially in Vietnam, but again the frequencies are very low.

Property Damage

The distributions on this variable mainly reflect the obvious. The lowest frequency categories are those with the highest amounts. Damage doesn't usually exceed $10,000 and rarely exceeds $100,000 (aircraft accidents and disasters are not included in this report). Most of the Army motor vehicle accidents fell within the $100-$999 category. Most of the private motor vehicle and other accidents are coded Not Applicable because either they don't involve property at all, or the property involved is not directly Army related, and is, therefore, not included in the present record system.

Corrective Action Taken

This variable is not too useful, mainly because the coding category of Training draws so much usage. It appears to be a truism that the human factor component to accidents is corrected by training. However, this variable does not give any clues as to who should be trained in what behaviors. The second most frequent category concerns Personal Adjustment which reflects the same type of thinking.

Engineering revision, which has represented the heart of the organized safety movement in the United States for the past 50 years, is almost universally the least designated appropriate action. Perhaps this indicates a feeling that the engineering "E" has done about all it can, and it is time to look elsewhere for a base for remedial programs.

Weather

This variable is almost useless in an overall summary because of the high proportion of cases across all types of accidents in which it is judged not to be a factor. Even in the relatively few cases where it is designated as a contributing factor, the only condition that occurs with any useful frequency is rain. It appears that this variable could be dropped from the present record system without influencing its present level of usefulness.

Supervision

This variable shows results very similar to that of Corrective Action. Everybody says that more instruction is needed. In the case of this variable, however, from 7% to 33% of the cases are coded None.

Agency of Accident

These distributions seem highly dependent upon the type of accidents considered. For Army motor vehicle accidents, trucks of one type or another are the main agency for accidents. For private motor vehicle accidents, commercial vehicles are the biggest factor.

For other accidents, animals and miscellaneous factors contribute most, while in Vietnam, logically enough, weapons and other instruments of war are mostly involved.

Unsafe Conditions

The usefulness of this category is greatly diminished because in 50% to 80% of the accidents, depending upon type, an unsafe condition is not associated with the accident in the record system. Other than this, mechanical defects and hazardous arrangements are the next highest frequency. It is difficult to coordinate this finding with the small frequency reported for need of an engineering improvement. Unless some peculiar definitions are being utilized, it would appear that engineering revisions might well correct some of the mechanical defects and hazardous arrangements.

Days Lost

Army motor vehicle accidents involve the No Lost Days category more than any other. They rarely concern either One Lost Day or Lost Days Over a Year. The category of 5-14 days is frequently used for both private motor vehicle accidents and other accidents. No Days Lost category is also somewhat frequent and again the One Day category and Over One Year category are only rarely used.

Nature of Injury

For Army motor vehicle accidents, this variable is often not applicable because of property-damage-only accidents. For private motor vehicle accidents, this does not hold true although there is still a substantial occurrence of property-damage-only accidents. This is probably a reflection of a bias in what enters the reporting system. The probability of a private motor vehicle property-damage-only accident finding its way into the Army accident record system is relatively small. Army motor vehicle accidents are more likely to enter the system with or without injury. In terms of injury accidents, Internal Damage category is most frequently used, followed by External-No Loss.

Location of Injury

The same reporting bias mentioned for Nature of Injury influences this variable. Other than that, head and leg injuries are on the top of the motor vehicle lists while leg and arm injuries top the other accident list.

Cause of Injury

Again the property-damage-only accidents require the frequent use of the Not Applicable codes for motor vehicle accidents, and again the difference between usage for Army and usage for private motor vehicles is an artifact of the present system. Other than that, for motor vehicle accidents, Struck Against With no Belt is the most frequent cause, and Struck by With no Belt is second. For other accidents, Struck By is the most frequent, followed by Falls.

Unsafe Act

For motor vehicle accidents, either No Unsafe Act or Using Unsafe Equipment or Using Equipment in an Unsafe Manner is the most frequently used code. Speed is usually in third order of importance. For Other Accidents. Unsafe Positioning and Distractions are somewhat more heavily used. Unsafe Equipment and Manner of Use as well as No Unsafe Act are also frequently used.

Unsafe Personal Factor

Regardless of the type of accidents considered, No Unsafe Personal Factor is recorded as being associated with the accident, at least a quarter of the time. Other than that, Improper Attitude and Lack of Knowledge, usually in that order, are associated with the accidents.

SUMMARY OF FREQUENCY DISTRIBUTION REVIEWS

The quick, once-over-lightly treatment this report gives is not meant to replace a more careful review of the computer printouts by the U.S. Army safety analysts. In more cases than not, the distributions tend to reflect truisms or, at best, situations which are already known to experienced safety analysts. They reveal a picture of characteristics associated with accidents as they are, but shed little light on why they are. Such data are useful for inventory and budget purposes, but are of only limited use for analytic purposes that are designed to lead to remedial activities to cut down the losses being experienced through death, personal injury, and property damage accidents.

Part III

IMPLICATIONS

The primary purpose of this project was to carry out a set of analyses in the hope of being able to (a) identify human factors associated with accident experience, (b) identify material and equipment design use characteristics associated with accidents, and (c) determine man/vehicle/equipment interactions and their influences on accident and injury incidents. The ultimate objective underlying the quest for a better understanding of these relationships was a desire to recommend and implement remedial activities that would tend to reduce the losses being suffered through death, personal injury, and property damage as a result of accidents.

Except in the most general terms, the results were less encouraging than had been hoped for. Perhaps no more than this should have been expected since the project in the attempt to address causality factors within a controlled analytical framework, utilized the data collected through an operational record system developed over the years essentially for inventory purposes. The fact that, for detailed analysis, critical data gaps existed in the present record system is not surprising. This situation is commonly found when there is an attempt to utilize data, collected for one purpose, for other related but different purposes.

ACCIDENT EXPERIENCE EVALUATION

A major problem in after-the-fact safety analyses throughout the years has been how to evaluate the "goodness" or "badness" of actual accident experience. Collecting the data in terms of numbers of mishaps, characteristics associated with each mishap situation, and the impact of the situation in terms of human and material costs is a tedious but relatively clear-cut function. This is basically what the present system has been geared to do and is doing on a comprehensive scale. Toward this end, it deals only with error situations, characteristics associated with error situations, and concomitant costs of these error situations. In order to evaluate such error data, measuring devices of some type are needed.

Arbitrary levels can be used for one such yardstick. For example, it can be said that any losses over a specified aggregate amount are worth investigating merely because of the size of the loss. The present system can adequately supply data for these types of evaluations.

Another type of evaluation concerns comparisons within the same organizations over a period of time. As long as the general parameters of the organizations (compared in terms of human and material resources, assigned operational missions, and prescribed operating procedures) do not substantially change over the periods of time involved, the present system can adequately supply data to evaluate whether changes have taken place. It will not, however, supply adequate data to address the question of why any changes that have taken place have occurred. The system simply is not oriented to that objective, and therefore does not collect basic data addressed to the answering of such questions.

Nor does the present system provide data that will permit a systematic appraisal of whether or not changes *should* have occurred because of such factors as changes in mission, operating procedures, and human and material resources. The present system merely provides continuing counts of experienced error data in a vacuum of expected error occurrence. This is the familiar problem of exposure or the population at risk, which has plagued safety researchers for years. The existing record system largely ignores this critical factor, forcing safety analysts to turn elsewhere to obtain this vital information as best they can.

From an evaluation standpoint, the lack of systematically collected exposure data specifically tailored for causal analytic purposes is the largest inadequacy of the present accident record system. Since this type of evaluation process was apparently not one of the major objectives for the present record system, this inadequacy is not necessarily derogatory. If the necessity for such evaluation processes is accepted, some methods must be introduced to provide the required exposure data on a more systematic basis than at present.

The indirect measure of exposure method developed by Thorpe, which was only sketchily applied in this project, needs further exploration. If through intensive, controlled studies, the validity of his assumptions can be determined, they may provide the needed exposure indices. It is recommended that such special studies be undertaken, directed toward the validation of this method or other methods that will provide continuing exposure indices sensitive to changing conditions.

It may also be useful to derive indices based upon relationships determined through regression analyses on Army-wide data that could be used at lower command levels in terms of their own operations. Thus, if certain relationships had been established between military manpower, mileage, and accident frequency or severity throughout the Army, these might be translated into absolute values for lesser commands. These values could then be used to determine the degree to which the experience of each command was similar to or deviant from Army-wide experience. This method might be useful for identifying and highlighting deviant situations, but it would be of little value in determining the reasons for the deviancy.

SYSTEM-RELATED CHARACTERISTICS

The experience of the project staff, in making the required analyses and utilizing data available from the present system, leads to the following observations concerning specific characteristics of the present accident record system.

(1) One characteristic is the reporting lag between the date of occurrence of the accident, the date it actually gets recorded on an official Army Accident Record form, and the date it is received by the Army Safety Division office. Depending upon the nature of the accident and its consequences and the command in which it occurred, the lag can vary from one to several months. The existing system of summarizing data at the Army Safety Division level has been based on date of receipt in Washington. While this may cause few problems in terms of present uses of the summarized data, it introduces an error component when causal analyses are attempted. All factors—human, material, or general environmental—are associated with date of occurrence and not date of reporting.

(2) The problem of multiple records per accident also presented some difficulties in interpretation. For some factors, there can be only one set of values associated with the accident, regardless of the number of people involved or the number of different owners of damaged property. The manner in which these were sometimes repeated in multiple

cards and at other times assigned by procedural rules to a Not Applicable category made the straightforward summary and analysis of these data more complicated than necessary. Perhaps the provision of some control data in Card Number 1, indicating the number of total cards associated with the particular accident, would be helpful. In any event, extreme care must be used in interpreting frequency data in order to filter out the effects of the multiple reporting or not multiple recording of various characteristics associated with certain types of accident experience.

(3) Another aspect of the present system that presented certain limitations for making causal analyses is the requirement to record only one characteristic when more than one was actually present. This holds true for some of the variables dealing with actions taken or conditions existing. If more than one action was taken or if more than one condition existed, the analyst or the coder is required to make a determination of only the major one, and record that. The information available at the time of the final coding decisions is often not complete, and all secondary or subsidiary actions or conditions do not find their way into the present report system. It has become generally accepted in safety circles today that accidents occur because of combinations of actions and conditions and not because of single factors. The present system procedures deny this type of basic data to the system. For purposes of causal analyses, this deficiency should be corrected.

(4) Also noted in the existing system is the presence and use of undifferentiating variables. For those characteristics or factors for which there is little internal variance, there can be little value in attempting to determine causal relationships. Weather as a factor is an example. When weather was consistently recorded as not being a factor for so many accidents, why is it continued in the record system? It would appear to be a valid factor, but experience apparently indicates that it is not. Several other variables also showed the preponderance of frequency in one or two coding categories. In such cases, these data are providing very little real information. It is recommended that the Army Safety Division take a detailed look at the distributions for the different variables to determine whether the present coding categories still satisfy current objectives, whether they might be changed to reflect changed objectives, or whether the same variables might be dropped from the record system entirely.

IMPLICATIONS FOR RESEARCH

Our experience in this project leads us to believe that more comprehensive analyses of Army-wide data, provided by the present system in order to identify human factors or material and design factors related to accident experience, would probably not be the most effective approach. The human and material factors included in the present system are recorded at a level too general to make such identification with any real degree of exactness. Data other than error or error-related counts are not included as an integral part of the present system. Such data, which can provide a yardstick for evaluation, should be included in future analytic studies.

In order to better accomplish the ultimate purposes of the Army Safety Division, a greater understanding of causal relationships is needed. Special studies, with a more limited but more intensive scope, should be undertaken to arrive at such understanding. In addition, rather than starting with the present data system and asking, "What can we do with it?" the Army Safety Division should start by asking, "What do we want to accomplish?" Once such basic analytic objectives are established, information requirements necessary for their attainment can be specified. The present record system can

then be examined to determine the extent to which and the manner in which it meets the informational requirements. Adaptation of the existing system or development of new system elements or total systems can then be undertaken to supply the necessary data.

The present system evolved over a period of years largely to provide data useful for reporting on certain aspects of safety for which the Army Safety Division has official accounting responsibility. The present system provides information for this purpose. As mi[illegible] emphasis shifts from accounting responsibility to causal analyses and remedial ac[illegible] programs, required system changes may be more easily accomplished through the development of new special-purpose data systems than through adaptation of the existing error counting system.