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Trends in Highway Information

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FOREWORD

This report documents a research study which examined what has happened to the quantity and quality of traffic accident reporting over the past decade and what is likely to happen in the coming decade. It should be valuable to researchers using accident data in highway safety analysis or individuals considering possible changes in accident data collection.

Sufficient copies of the report are being distributed to provide two copies to each Region and Division and a minimum of one copy to each State highway agency. Direct distribution is being made to the Divisions.

R. J. Betsold
Director, Office of Safety and Traffic
Operations Research and Development

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I. INTRODUCTION

Issues

Highway safety professionals responsible for highway design and operation in the United States have been increasingly concerned during the past few years that restricted resources for police accident reporting, and for related data collection and processing, are threatening the effectiveness of programs designed to make traffic operations and the highway environment safer. This study was undertaken to look at trends affecting the availability of the data needed to support effective safety programs and to determine how adverse trends might be countered. The results of the study are optimistic. On a national basis, deterioration of police accident reporting has been less severe and less widespread than was generally thought to be the case. Although limited resources have created continuing pressures to cut back the collection and processing of safety-related data, technological advances and increased recognition of the importance of safety programs have been sufficient to prevent serious deterioration in most States.

Concern about deterioration of police accident reporting has led to a search for alternative sources of data to identify safety problems and evaluate programs. The findings of this study indicate strongly that police accident reporting will continue to be the major source of supporting data for the foreseeable future and that efforts should be focused primarily on improvement in the quality and availability of driver and police reports rather than on development of alternatives. Where police reporting thresholds are too high to provide data in sufficient quantity, driver reporting of accidents should be considered as a supplement to police reports. Other sources of accident or accident surrogate data -- hospital records, maintenance records, traffic conflicts studies, etc. -- are useful for specialized applications but will not replace accident reporting.

Pressures to reduce police accident reporting and associated data processing are largely a result of budget constraints at State and local levels of government. In general, reductions are achieved by raising the threshold for reporting of property-damage-only accidents (PDOs). Such reductions do not appear to be cost-effective. To put the cost of PDO data in context, it is estimated that collecting and processing these data is in the range of ten to twenty dollars per accident. With thresholds commonly used by the States during the past several years, there are generally from two to three reported PDOs for each reported injury accident. With approximately three million injury accidents reported annually, the cost of PDO data might be as much as $180 million per year. This is a large investment, but it should be considered in conjunction with losses from traffic accidents. These losses are approaching $60 billion per year according to the National Safety Council estimate for 1986. (19) Based on these figures, the cost of PDO data is about 0.3 percent of the cost of accident losses. Properly used for developing and evaluating safety programs, PDO data should help to reduce traffic fatalities, injuries and property damage by an amount that far exceeds their cost. The cost of PDO data might also be considered in conjunction with the annual investment in safety programs. In 1976 the Secretary of Transportation reported to Congress that annual expenditures for safety programs were over $7 billion. (35) Of this amount, 85 percent came from State and local governments and the balance was funded by the Federal government. The Secretary emphasized that more and better data would permit decision makers to make more effective use of limited resources.

In the recent past, when large computers were needed to process voluminous accident data files, State agencies tended to dominate the development of safety recordkeeping systems. Local governments were valued largely as contributors of accident reports and often got little benefit in return from the State. Only large cities and counties had the resources to develop independent systems and were able to give first priority to local needs. With the advent of microcomputers, the situation has changed. Now any city, town or county can develop its own accident data system at a modest cost and can operate a safety program without data from State files. Thus there is little incentive for local agencies to submit accurate and timely accident data to the State unless the State reciprocates with something of value. Some States have recognized the change in the balance of power brought about by the use of microcomputers and are now dealing with local governments as partners with an equal interest in the development of efficient comprehensive computerized safety recordkeeping systems. In those States, State and local agencies are working together to take advantage of the local capacity to collect data and the State capacity to manage a large data base for the benefit of both State and local users.

If current trends continue, effective safety recordkeeping systems will be developed in a few States where top administrators recognize the value of these systems and the need for constructive coordination among State and local officials responsible for the collection and use of data for safety program management. In these States, available Federal, State and local funds will be invested in safety programs with confidence that benefits will be substantial. Other States, with weaker safety recordkeeping systems, will have less assurance that their funds are not being wasted on ineffective safety projects.

Approach

To determine what has been happening to the quantity and quality of State traffic accident data and other safety-related data over the past decade and what is likely to happen in the coming decade, the study team reviewed pertinent literature, studied trends in the number of accidents reported by a number of States, and interviewed officials in several State and local governments. The conclusions which were reached reflect what was learned from these sources. They are not intended to represent, in any sense, a consensus of the officials who were contacted.

II. AREAS FOR ACTION

Police Accident Reporting

Police accident reports provide the base that supports almost all highway safety programs. Without the data that are routinely collected by local and State police, it would be impossible to determine with confidence where safety problems exist and what countermeasures are effective in resolving them. If three PDOs were reported by the police for each reported injury accident, there would be an average of about two reported accidents per year for each mile of road in the United States. Current reporting is below this level in most States. Reductions in PDO reporting result in failure to identify hazardous highway segments, skewed data on the relative distribution of accidents, inaccurate presentation of accident patterns, insufficient information for selection of accident countermeasures, unreliable benefit-to-cost ratio analyses, underestimated benefits of safety projects, and increased losses in tort cases. PDO reporting is especially needed for development of safety improvements on lightly traveled roads because of the statistical uncertainties associated with small numbers of accidents; these uncertainties rise sharply when the level of accident reporting goes down. For these reasons, highway designers and traffic engineers involved in local, State and Federal programs for improving the safety of highways in the United States depend heavily upon the police to provide the information they need to support their decisions.

Reporting Thresholds

Traffic accidents are events that result in personal injuries or damage to property. About two million injury accidents are reported in the United States each year by police. This includes roughly 40,000 fatal accidents. There is a general consensus that collection and processing of injury accident data is a worthwhile police function. It has long been recognized, however, that many noninjury or property-damage-only accidents (PDOs) are trivial. Collection and processing of data for the least severe of these is not a wise use of the limited resources available for highway safety. Estimates of the total number of property damage accidents are highly speculative, but tend to fall in the range of 15- to 20-million per year. States have limited their collection of PDO data for many years to those PDOs in which damage equals or exceeds specified dollar thresholds. Some of these thresholds are based on the total damage in an accident while others refer to the damage to property of any one person.

In 1977, Pennsylvania introduced a "tow-away" threshold for PDO reporting by requiring reports only when one or more vehicles is damaged to an extent that it cannot be driven and must be towed. Florida followed with a similar tow-away threshold in 1983. In most States, PDO reporting thresholds are established by laws which specify the level at which drivers must report accidents. By administrative action, police generally adopt the same thresholds for their reporting. In 1979, however, without any legislative action to adopt a "tow-away" standard for PDO reporting, a number of police agencies in Maryland administratively adopted the tow-away threshold. Some other States have considered conversion from a dollar threshold to a tow-away threshold but have elected not to switch because of objections by users of the accident data.

Table 1 summarizes the thresholds that govern the reporting of PDO accidents in the nine States visited by the study team. Most of these States have raised their reporting thresholds over the past ten years to accommodate the increased cost of repairs or replacement resulting from inflation, to reduce police work load, or to accommodate budget and personnel cutbacks affecting the processing and analysis of accident data.

For this study, it was necessary to develop an indicator to determine whether the level of PDO reporting has been changing. On the assumptions that injury accident reporting is relatively stable and that, based on observations of the relationship between fatal accidents and other injury accidents, the average severity of accidents is not changing substantially, it was concluded that the ratio of PDOs to injury accidents would be a useful indicator. Where the percentage of PDOs that were reported did not change over the past decade, the ratio of PDOs to injury accidents would have been expected to rise slightly as the cost of repairing or replacing damaged property was driven up by inflation. As is evident in the material which follows, many States have established reporting thresholds at a level where the ratio of PDO's to injury accidents is between 2 and 3. This level appears to be generally acceptable to major users of the accident data. Ratios for the States visited in this study are shown graphically in this section.

Summaries of the Illinois accident data from 1975 to 1985 are shown in figures 1 and 2. In Illinois, State law requires that reports of all accidents investigated by law enforcement agencies be forwarded to the DOT. Motorists are required to report all accidents involving personal injuries or property damage of $250 or more. This threshold has been in effect for many years. The Illinois ratio of PDOs to injury accidents (see figure 1) has been over 3 and relatively unchanged for the past 10 years. (27) A small decline in the ratio in 1980 was due in part to reduced reporting by local police in urban areas. Chicago's PDO reporting procedures have a substantial impact on the Illinois data. The city's current position on PDO accidents requires motorists to come to the police station and fill out a desk report; this tends to reduce the number of reported PDOs. Note in figure 2 that the number of reported PDOs in rural areas has not changed over the past 10 years despite the substantial

TABLE 1. Summary of accident reporting requirements governing reporting of property-damage-only accidents

STATE	REPORTING THRESHOLD(S)
ARIZONA	\$300 (Prior to 1980) \$500 (1980 to Present)
CALIFORNIA	\$250 (1975 to 1979) \$350 (1979 to 1980) \$500 (1980 to Present) (Police agencies are not required to report PDO accidents)
DELAWARE	\$250 (1973 to 1987) \$500 (1987)
FLORIDA	\$50 to \$100 (Prior to 1976) \$200 (1976 to 1983) Tow-away and/or injury accidents (1983 to Present)
ILLINOIS	\$250 (Prior to 1975 to Present)
MARYLAND	\$100 (Prior to 1979) Tow-away (1979 to Present)
MISSOURI	\$500 (1975 to Present)
NEW YORK	\$200 (1970 to 1978) \$400 (1978 to 1985) \$600 (1985 to Present)
PENNSYLVANIA	\$200 (Prior to 1977) Tow-away (1977 to Present)

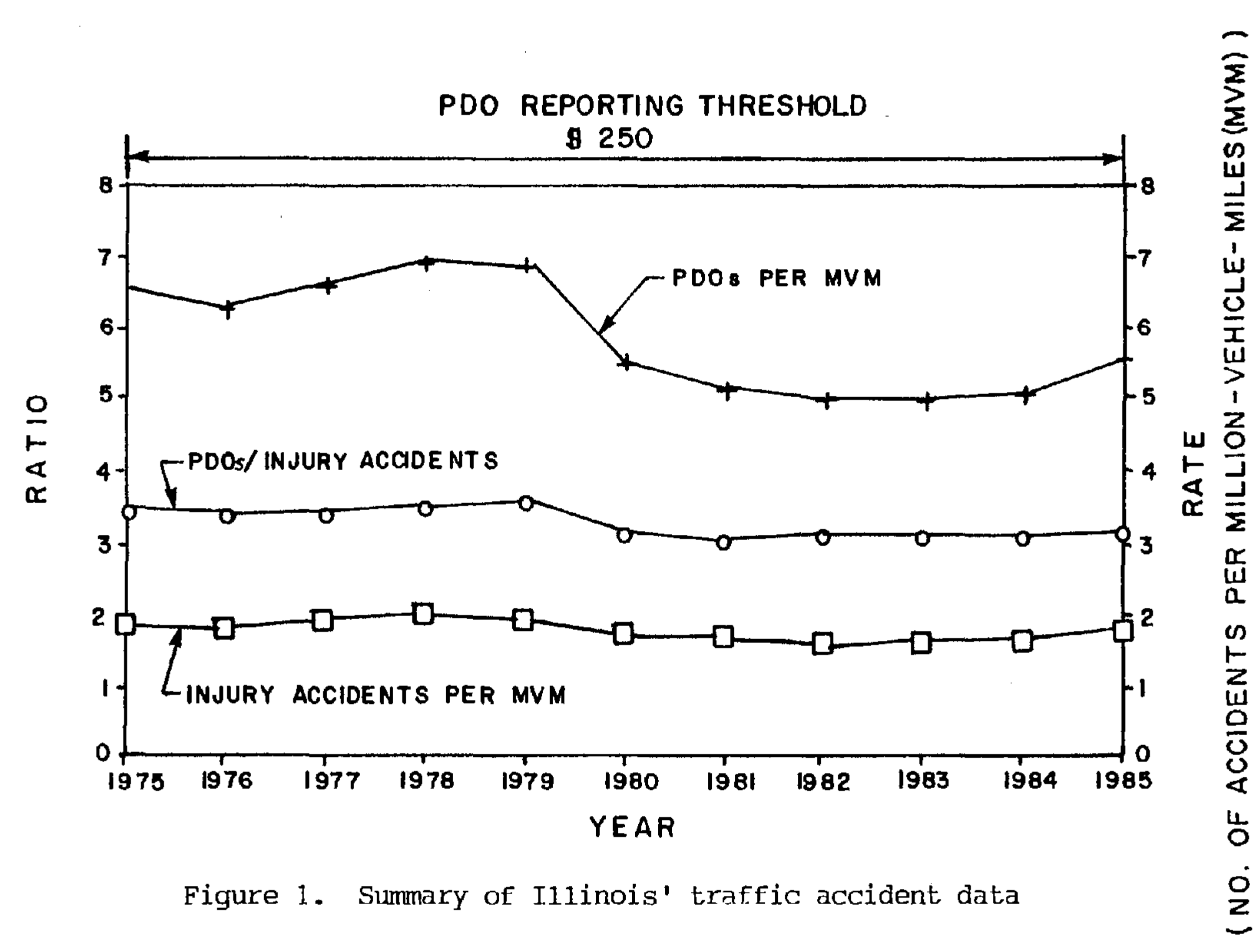


Figure 1. Summary of Illinois' traffic accident data

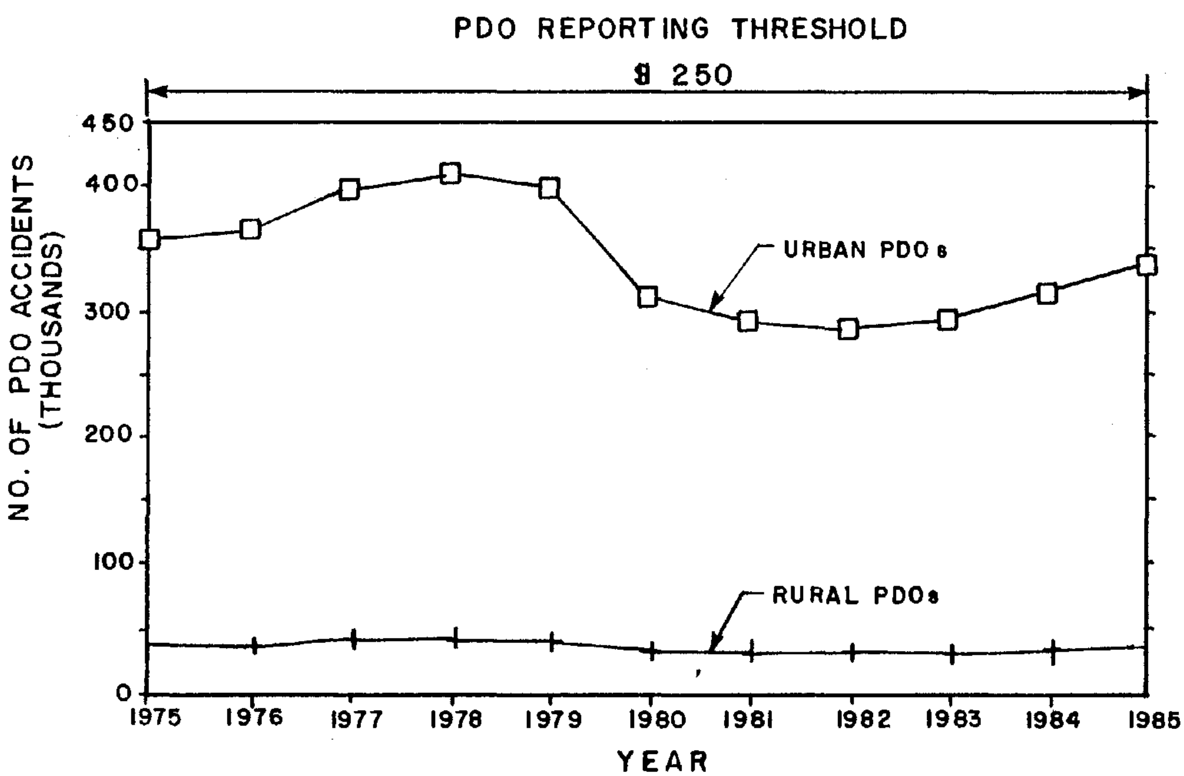


Figure 2. Summary of Illinois' urban and rural PDOs

drop that occurred in urban jurisdictions between 1979 and 1980. The large difference between rural and urban PDOs in figure 2 reflects the fact that more than two-thirds of Illinois travel is in urban areas and, probably, that the level of PDO reporting in urban areas is better than in rural areas.

Delaware's traffic accident data for the past 10 years are shown in figures 3 and 4. There has been no degradation in the level of reporting since 1975; the ratio of PDOs to injury accidents has risen gradually for several years to about 2.5. The $250 reporting threshold has been in effect since 1973. (2) In mid-1987 the Delaware legislature raised the dollar threshold for PDOs from $250 to $500, as requested by Delaware's law enforcement agencies. In response to the potential change in the PDO reporting threshold, Delaware's DOT officials conducted a study to examine the potential impact of the proposed $500 threshold. The study estimated that 20 percent of normally reported PDOs would be lost. However, Delaware DOT staff is convinced that this loss is temporary and will be regained in less than four years after the new threshold is implemented, based on a four to five percent annual increase in reported PDO accidents.

The downward trend in the ratios of PDOs to injury accidents in figure 5 shows that, contrary to experience in Delaware, PDO reporting in Missouri slipped from 1979 to 1983. During those years some local jurisdictions reduced their PDO accident reporting. Figure 6 shows that most of the reduction was off the State highway system. As a result of the reduction, a standing committee of State and local police and highway officials was created to combat further deterioration in the level of reporting PDO accidents. Since then, the level of cooperation in reporting PDO accidents has been excellent. The number of police-reported PDO accidents depends largely upon the willingness of law enforcement agencies to collect the data and upon adequate police manpower and funds. In Missouri, the budget for the State patrol comes from the Missouri State Highway Commission. This administrative environment has fostered a good working relationship between police and highway officials. Also, the availability of an accident reporting training course at Central Missouri State College has aided instruction of local police on the importance of accurate reports. Missouri officials indicated that no substantial reduction in the level of PDO accident reporting has been observed since 1983. This observation is consistent with the increase in the ratio of PDOs to injury accidents shown in figure 5. The 2.6 level of the ratio in 1986 indicates strong emphasis on PDO reporting.

Graphic summaries of Arizona traffic accident data for the past 10 years are shown in figures 7 and 8. Figure 7 illustrates the change in number of PDOs per million vehicle-miles, the PDO-to-injury-accident ratio, and injury accident rates. Figure 8 illustrates the PDO reporting level on urban and rural facilities in Arizona. A major reduction in reported PDOs occurred in 1980

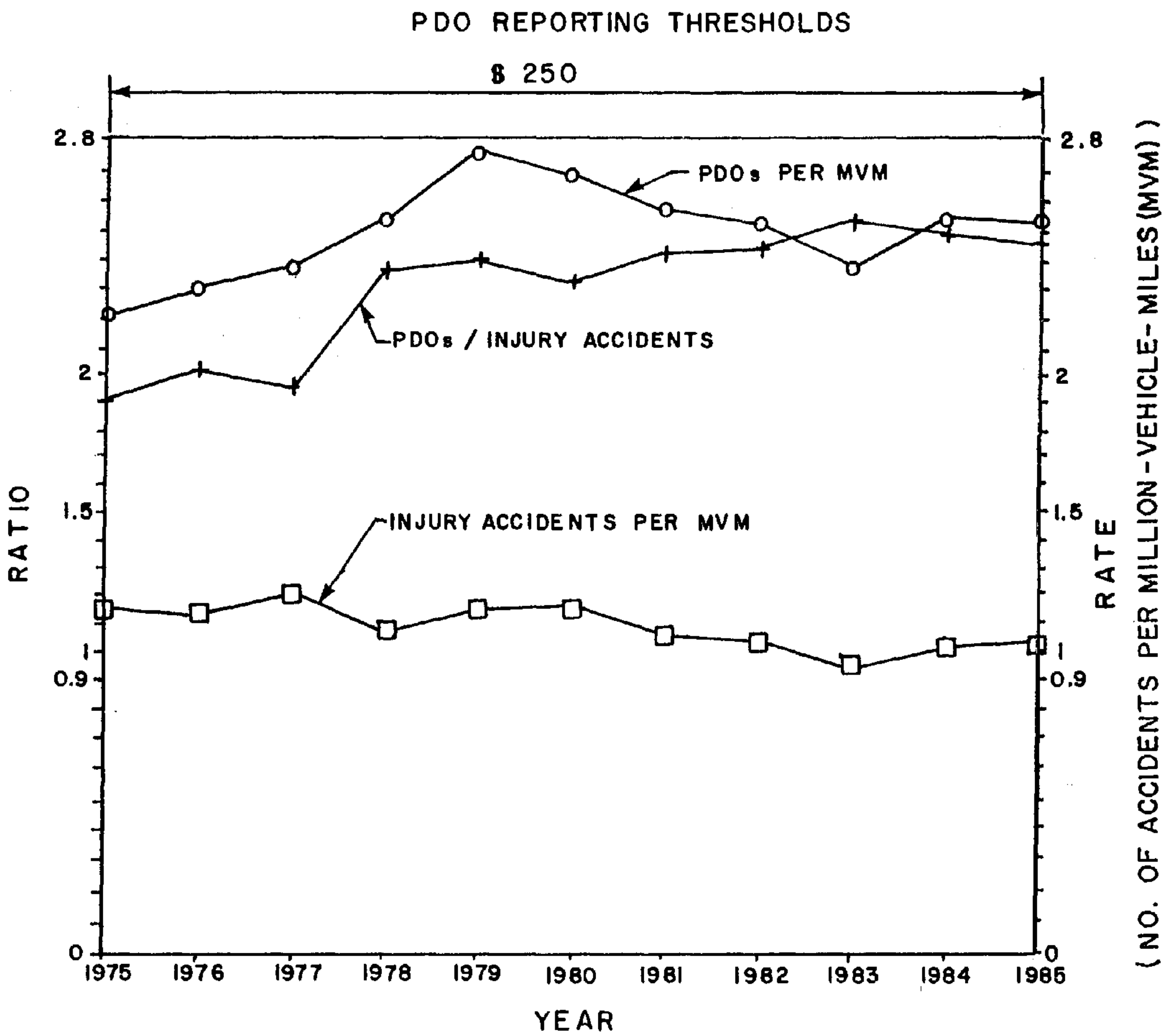


Figure 3. Summary of Delaware's traffic accident data

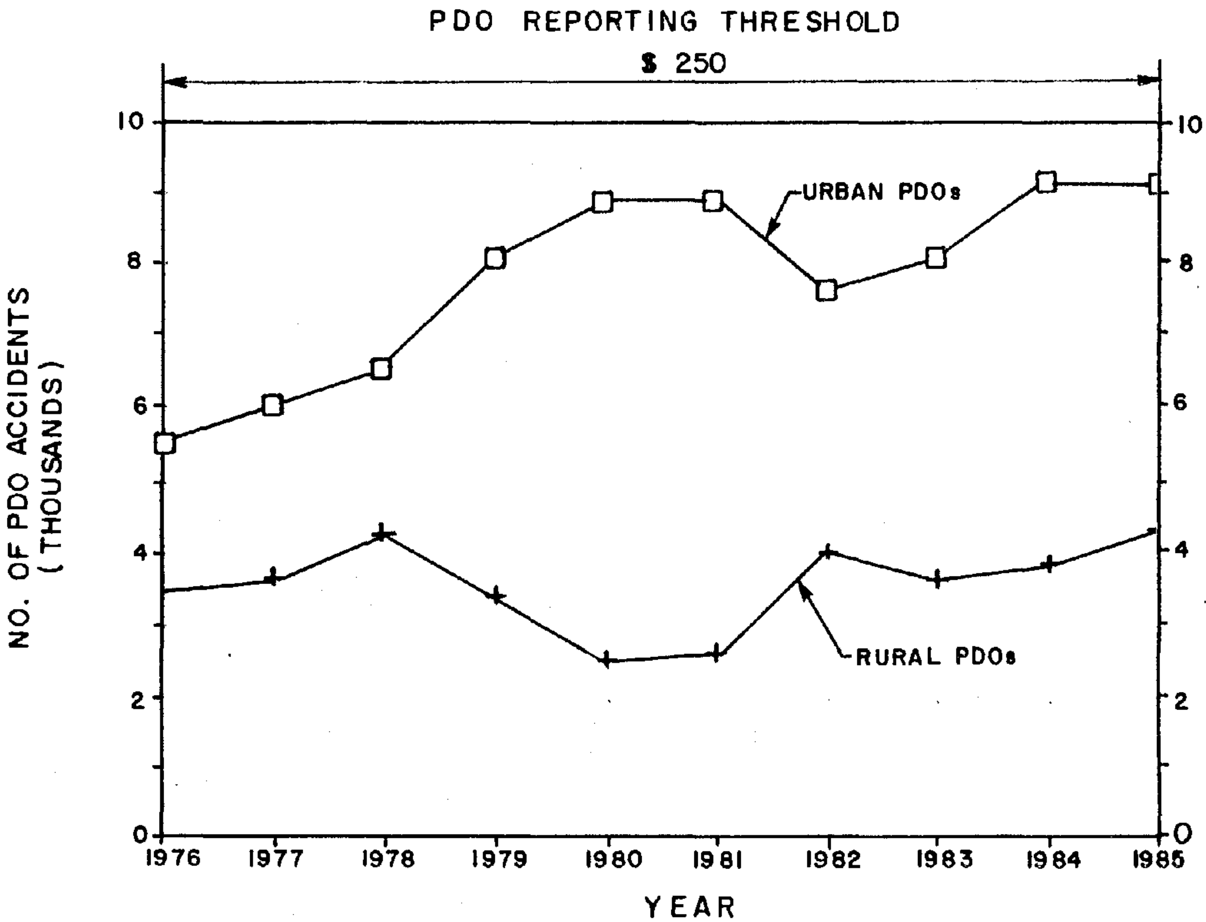


Figure 4. Summary of Delaware's urban and rural PDOs

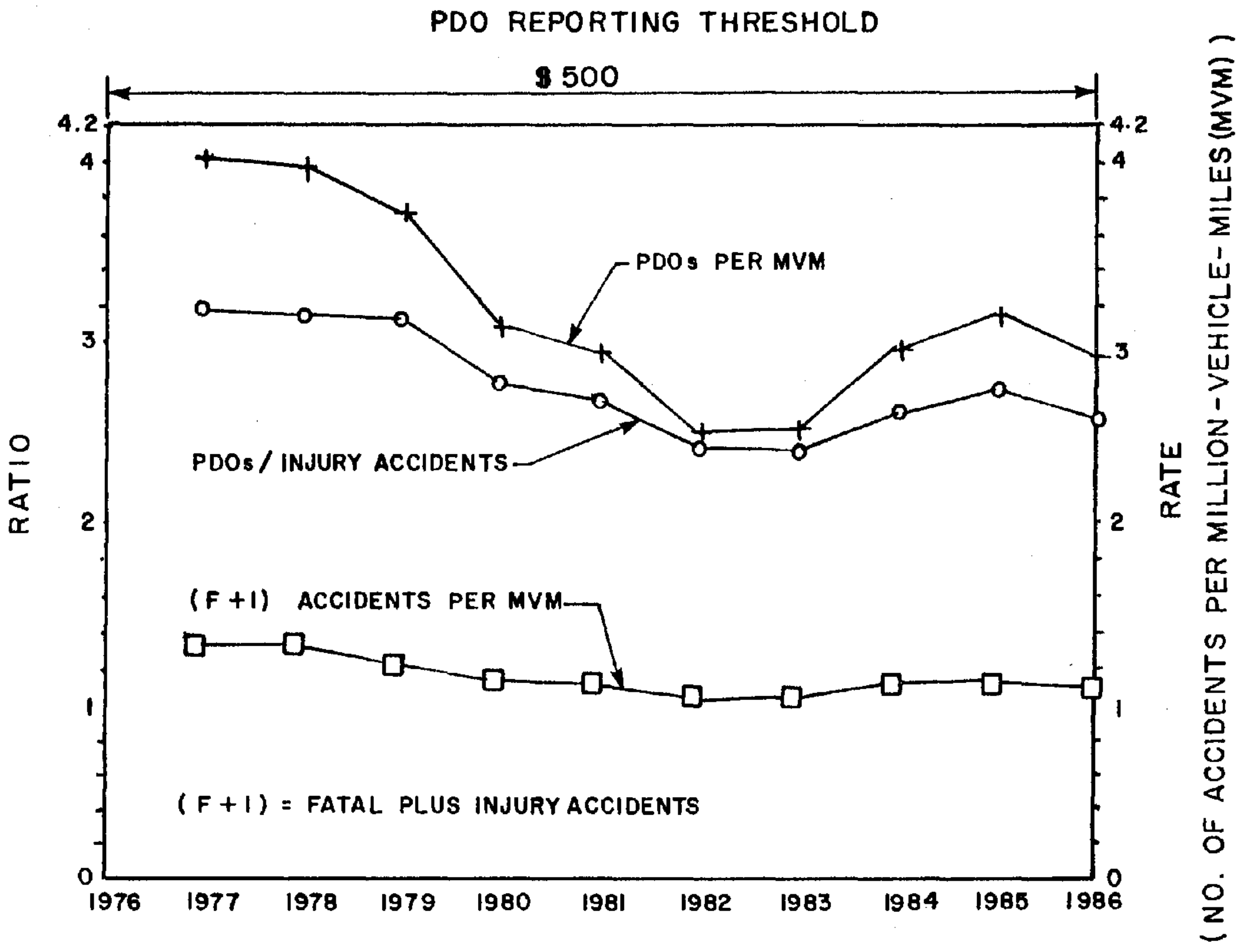


Figure 5. Summary of Missouri's traffic accident data

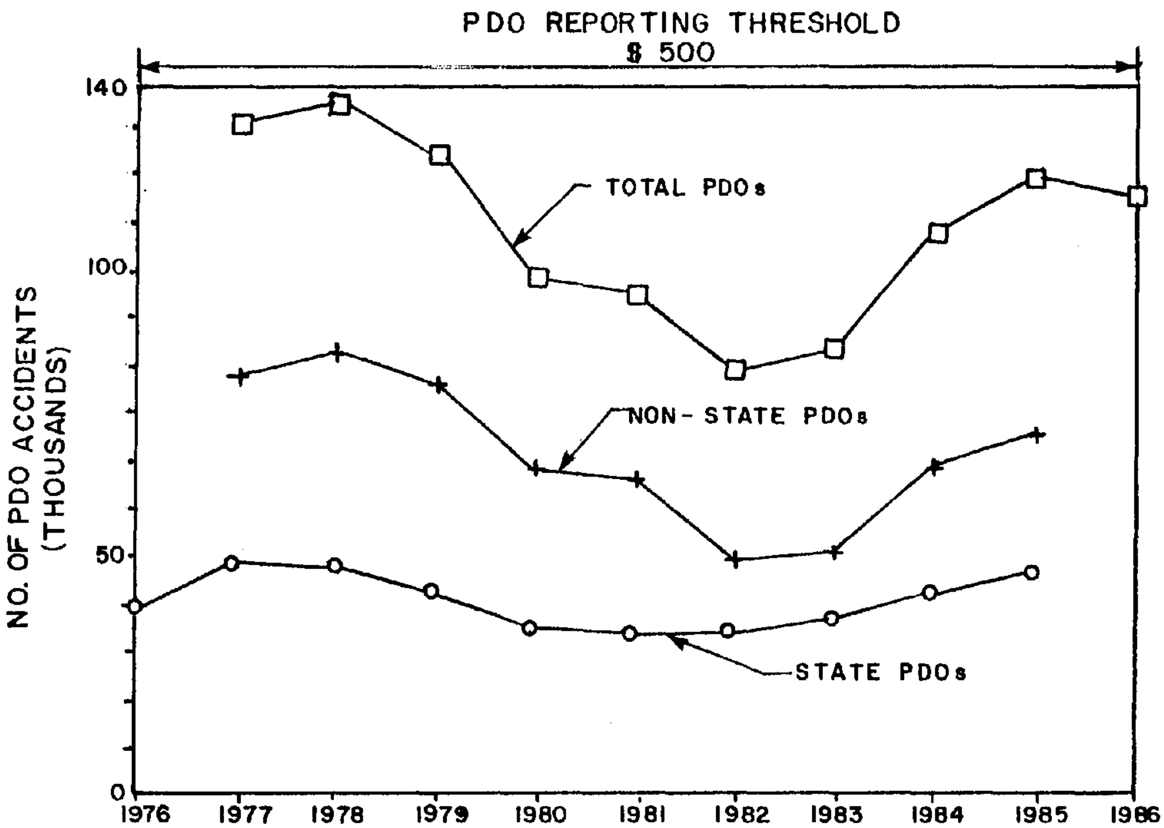


Figure 6. Summary of Missouri's State and non-State PDOs

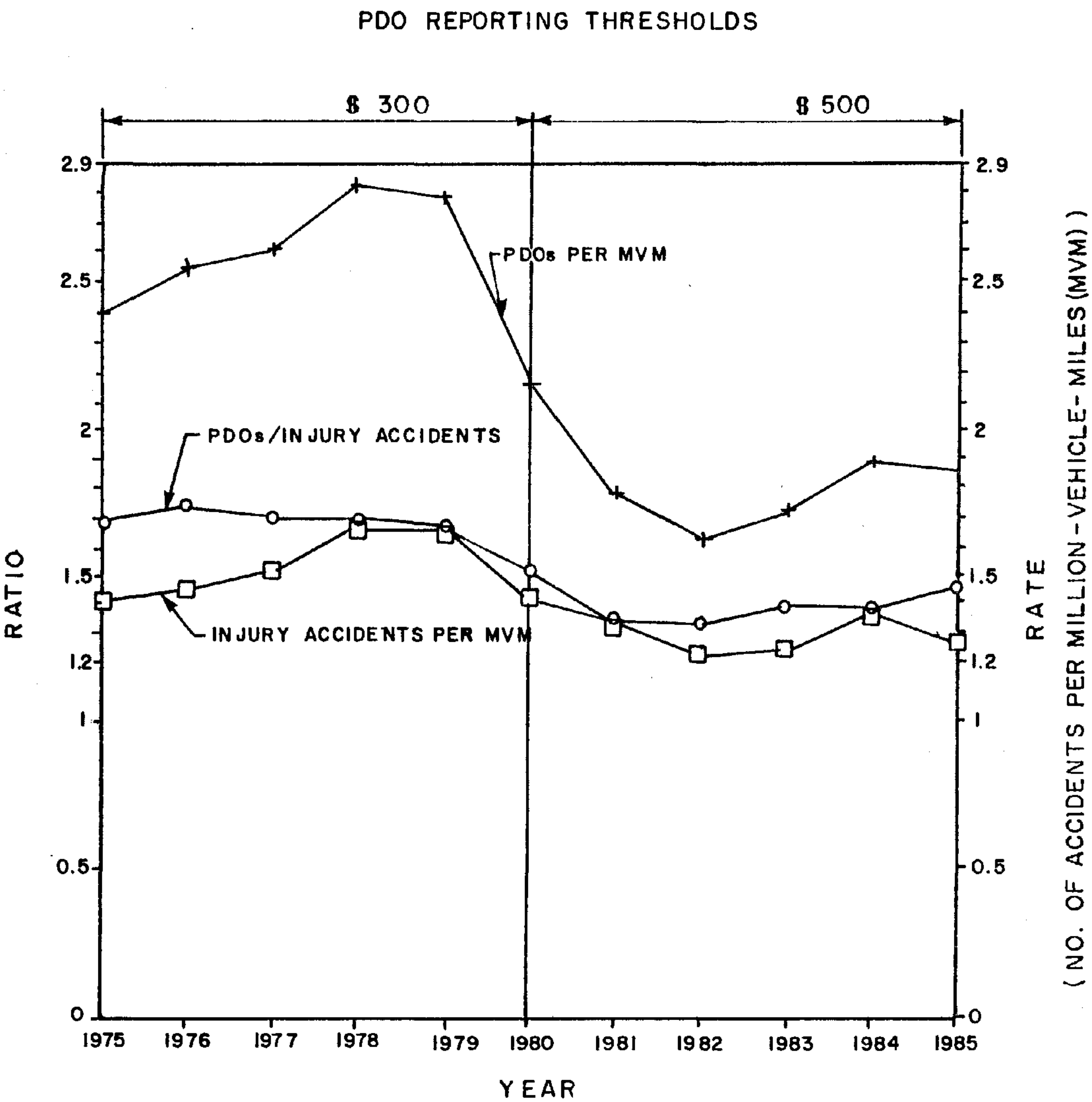


Figure 7. Summary of Arizona's traffic accident data

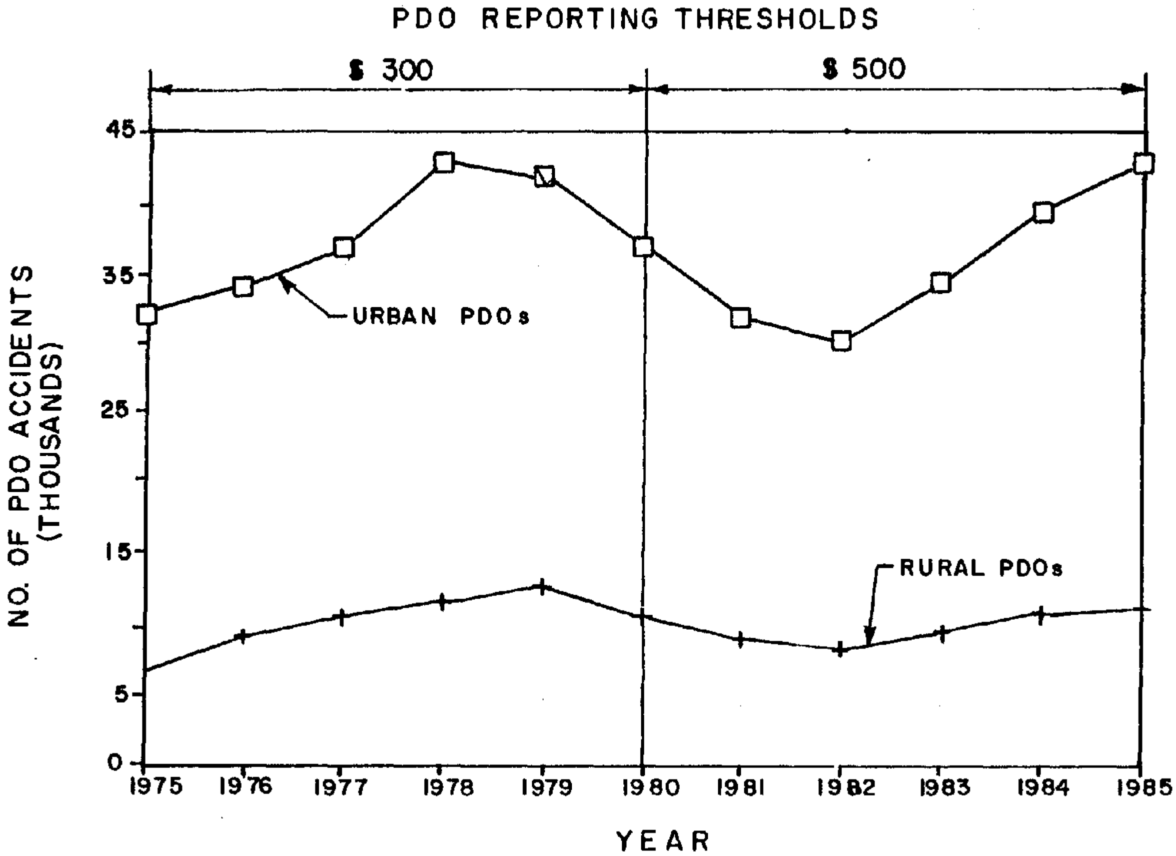


Figure 8. Summary of Arizona's urban and rural PDOs

and 1981 as the reporting threshold was raised from $300 to $500. The drop in the ratio of PDOs to injury accidents shown in Figure 7 reflects the threshold increase. Note that the magnitude of the ratio, about 1.5, is substantially lower than the ratios of the States described above. It has not been established whether this difference is due to highway operation characteristics or to reporting practices.

In California, State highway officials have expressed great concern about the reduced level of PDO accident reporting by local jurisdictions. Although police agencies are not required by law to investigate and report PDOs, California highway agency engineers have indicated that the underreporting of PDOs by local jurisdictions to the State is a serious problem. In large part, the problem is failure to forward reports to the State rather than failure to collect the data. Graphic summaries of the data are shown in figures 9 and 10. Figure 9 indicates that the PDO-to-injury-accident ratio decreased steadily from 1.8 to 1.3 in the period from 1976 through 1983. The ratio recovered slightly in 1984 and 1985. The low ratio reflects the failure of major cities to forward PDO reports to the State. Figure 10 shows little change in the number of reported PDOs on State and other roads during the decade although vehicle-miles traveled increased by 46 percent.

In Pennsylvania, prior to 1977, PDO accidents were reportable if any of the vehicles involved sustained more than $200 damage. However, the dollar value criterion was considered unsatisfactory and, as a result, a new motor vehicle regulation replaced the dollar threshold value for reporting PDOs with a tow-away criterion. (13) The "dollar amount" criterion was viewed as unsatisfactory for several reasons: (1) the actual dollar amount had to be adjusted annually for inflation; (2) the criterion is not a stable measure of accident severity, since the repair cost for similar vehicle damage varies among vehicles; (3) costs for repairs may vary widely from one repair shop to another; and (4) many of the very low severity accidents which were being reported were not of much interest to the Pennsylvania Department of Transportation.

Since the cost of repairs is not required, there is little question that the tow-away criterion makes it easier for motorists to determine whether a PDO is reportable. A tow-away threshold also cuts data collection and processing costs substantially. However, because of the drastic cut in the number of reported accidents when a tow-away threshold is adopted, the reliability of hazard identification and project evaluation based on accident data drops markedly.

The effect of Pennsylvania's tow-away policy has been an overall reduction in the number of reportable PDOs. Traffic accident data from 1975 to 1985 are shown in figure 11. From 1976 to 1978, as the tow-away threshold was introduced, the ratio of PDOs to injury accidents dropped about 75 percent. It has declined about 20 percent more since 1978, which could indicate that accident severity in Pennsylvania is rising or that the level of PDO reporting is decreasing.

The law establishing the tow-away criterion for reporting PDOs in Florida was enacted in 1983 in order to allow police to spend more time on crime-prevention work. In spite of its efforts, the Florida Department of Transportation was unable to prevent the tow-away threshold from becoming law.

Over the past ten years, the Florida Department of Transportation has lost approximately 60 percent of the PDO accident data base. (31) As is apparent in figure 12, most of the reduction occurred in 1984 when a $200 reporting threshold was replaced by a new tow-away reporting criterion. From 1983 to 1984, the number of PDO accidents per million vehicle-miles traveled declined from 3.12 to 1.27 and the PDO-to-injury-accident ratio declined from 2.0 to 0.8. Note that the level of the ratio is somewhat higher in Florida than in Pennsylvania, perhaps because of differences in traffic operating conditions. The injury accident rate remained relatively constant in Florida throughout the 1975-1985 period. Figure 13 shows that the relative decline in PDO accident reporting was essentially the same on both urban and rural facilities.

Maryland has also experienced reduced reporting of PDO accidents as police agencies have converted to tow-away reporting thresholds. Unlike the changes to tow-away thresholds in Pennsylvania and Florida, tow-away reporting thresholds in Maryland were adopted initially by a number of county police departments because of manpower shortages. The practice was subsequently adopted by the Maryland State Police and the City of Baltimore. Traffic accident data for Maryland -- shown in figure 14 -- indicates that during 1978, the last full year before the adoption of tow-away thresholds, the police wrote reports on 130,000 accidents. At that time, accidents were reported if any of the vehicles involved more than $100 damage. During 1980, the first full year after the new thresholds went into effect, only 80,000 accidents were reported. (11) This represented a loss of about 1,000 reports per week and amounted to a reduction of almost 40 percent in the total number of accidents reported two years earlier. Reported PDOs decreased by 50 percent from 1978 to 1980, and reported injury accidents decreased by 10 percent. (11) During 1984, approximately 90,000 accidents were reported, less than 70 percent of the number reported six years earlier, despite a 15 percent increase in vehicle-miles traveled. (11) Since 1980, the PDO-to-injury-accident ratio has been quite stable, indicating that the conversion to tow-away thresholds has not spread much beyond the police agencies that made the change in 1979 or 1980. The magnitude of the ratio is about double that of the ratios in Pennsylvania and Florida, where the tow-away threshold is used on a Statewide basis.

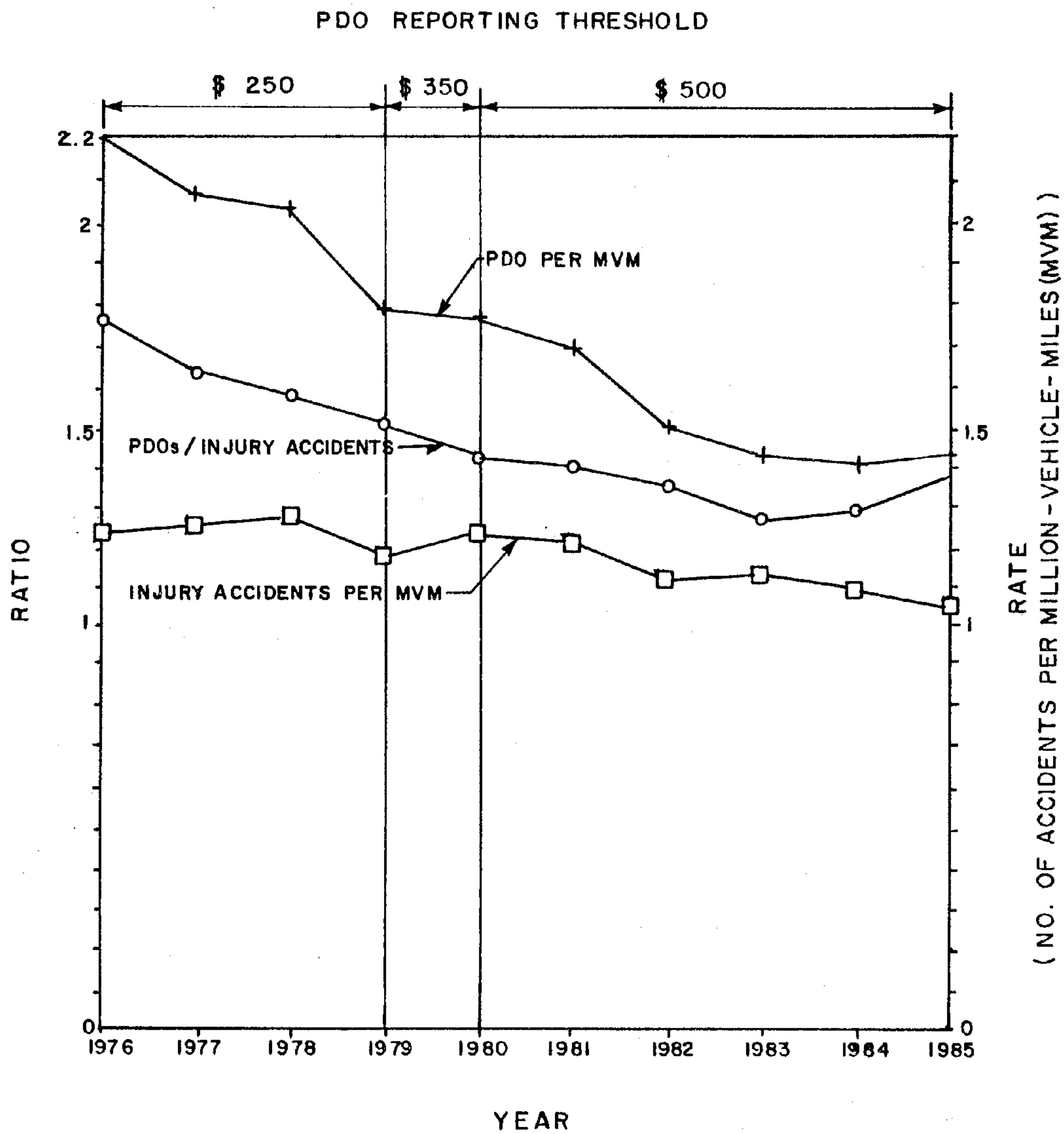


Figure 9. Summary of California's traffic accident data

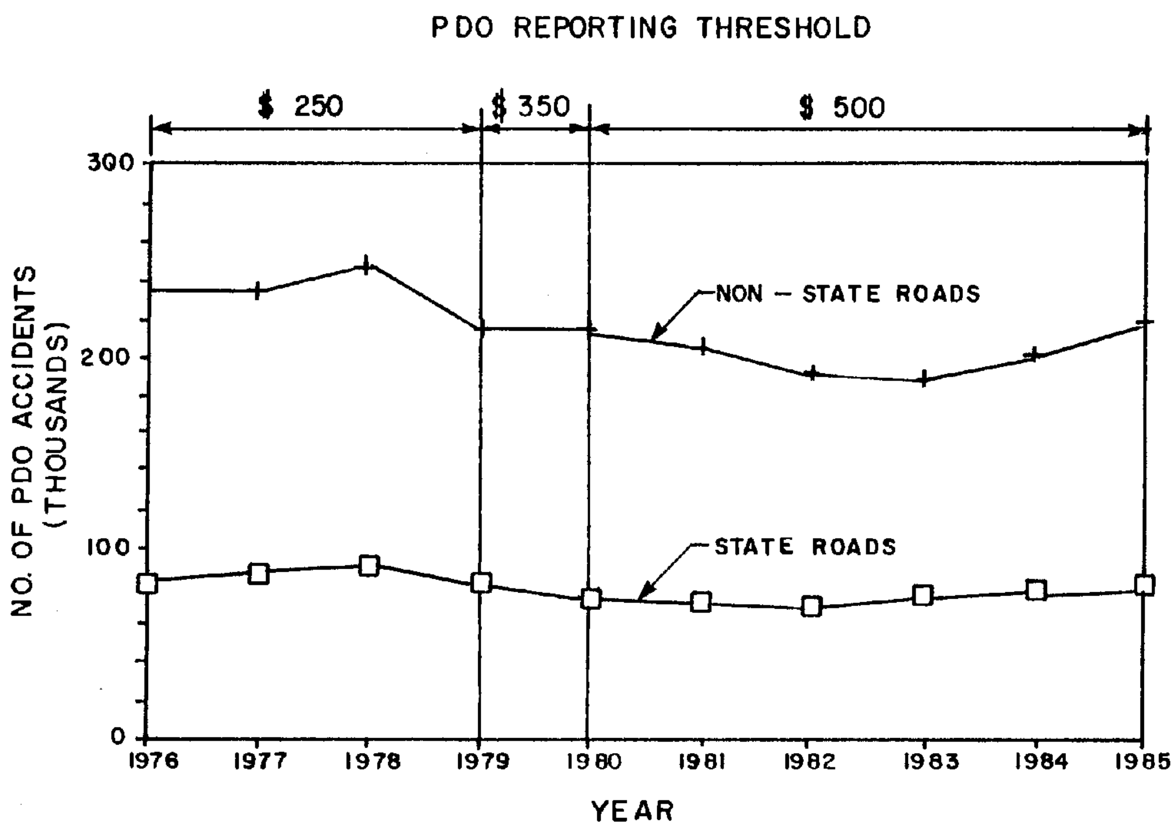


Figure 10. Summary of State and non-State PDOs in California

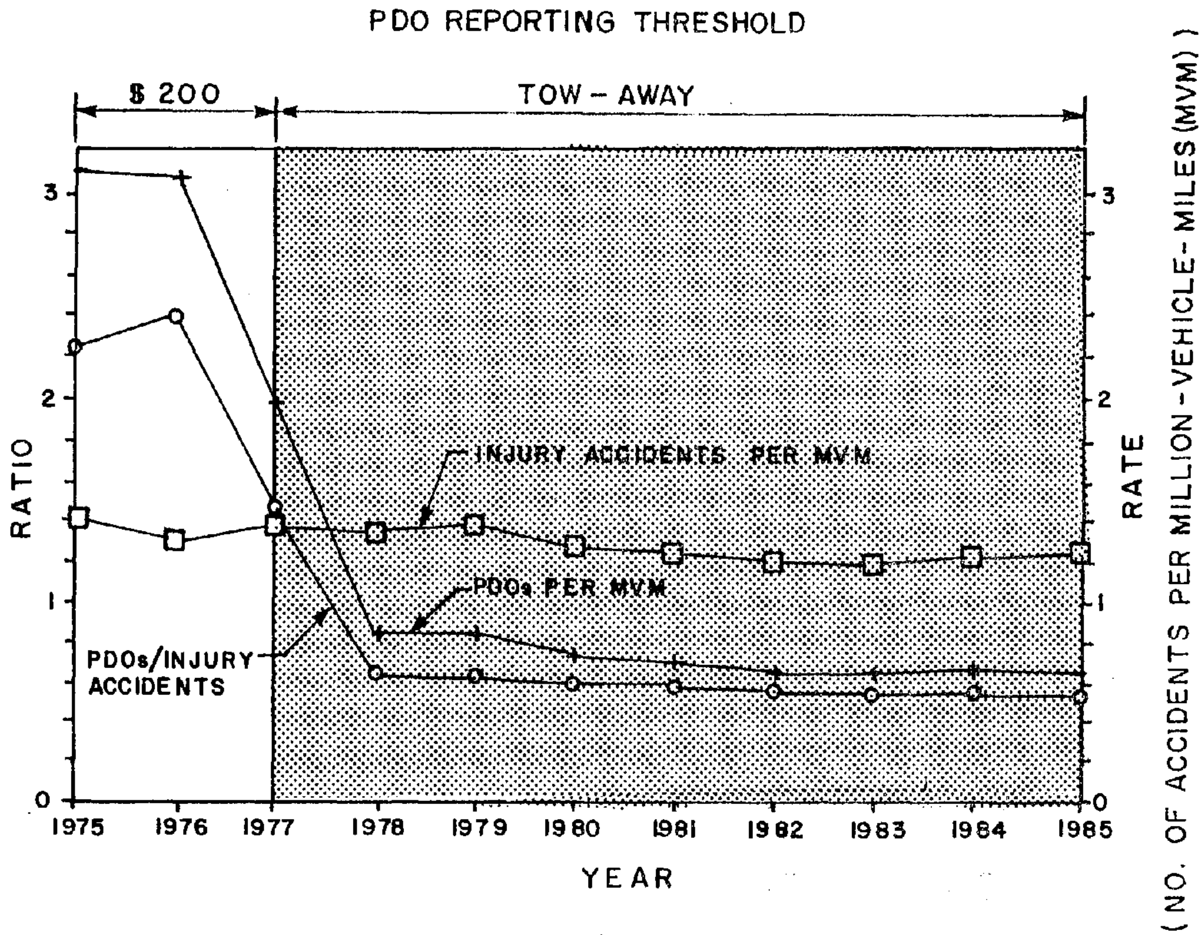


Figure 11. Summary of Pennsylvania's traffic accident data

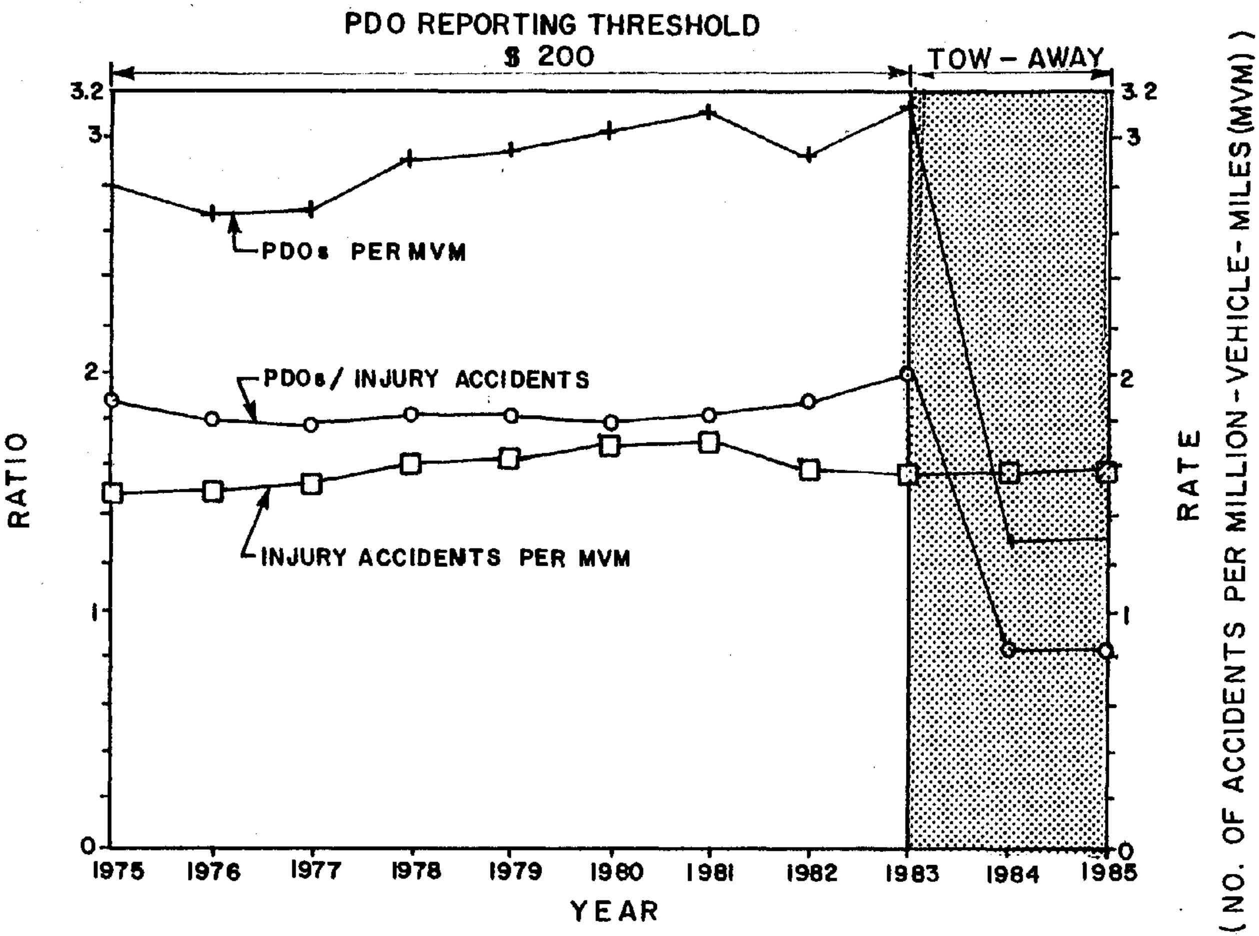


Figure 12. Summary of Florida's traffic accident data

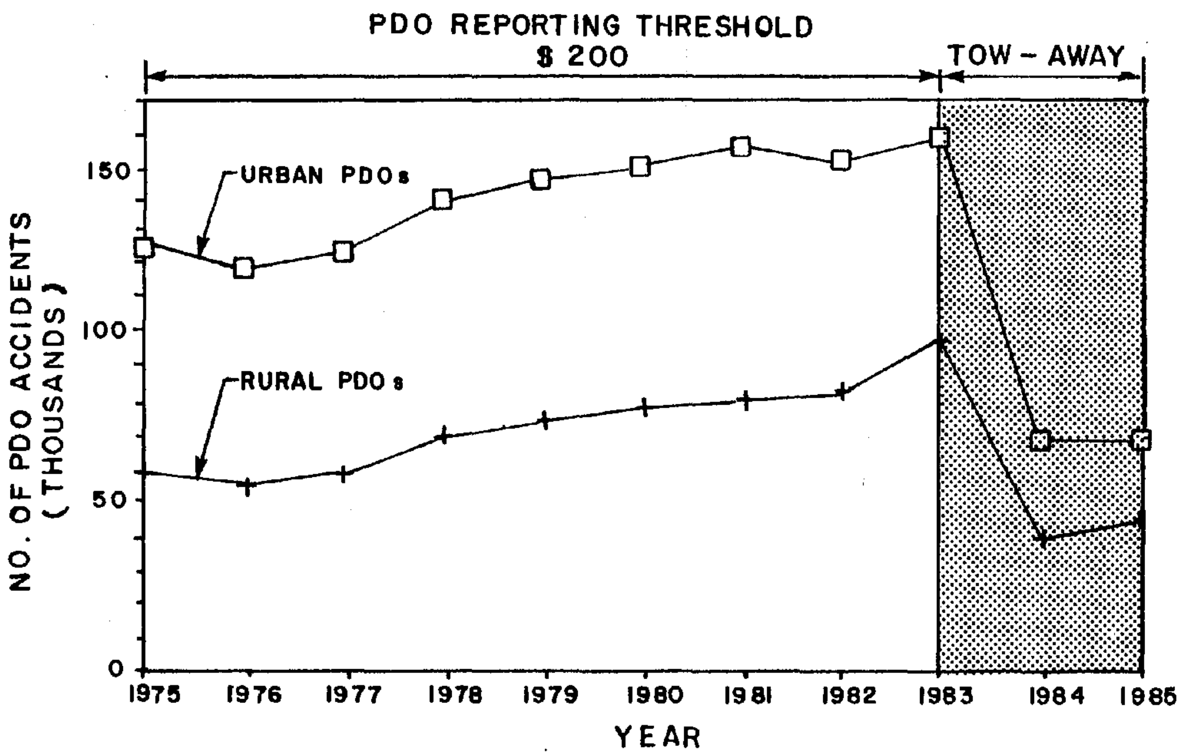


Figure 13. Summary of Florida's urban and rural PDOs

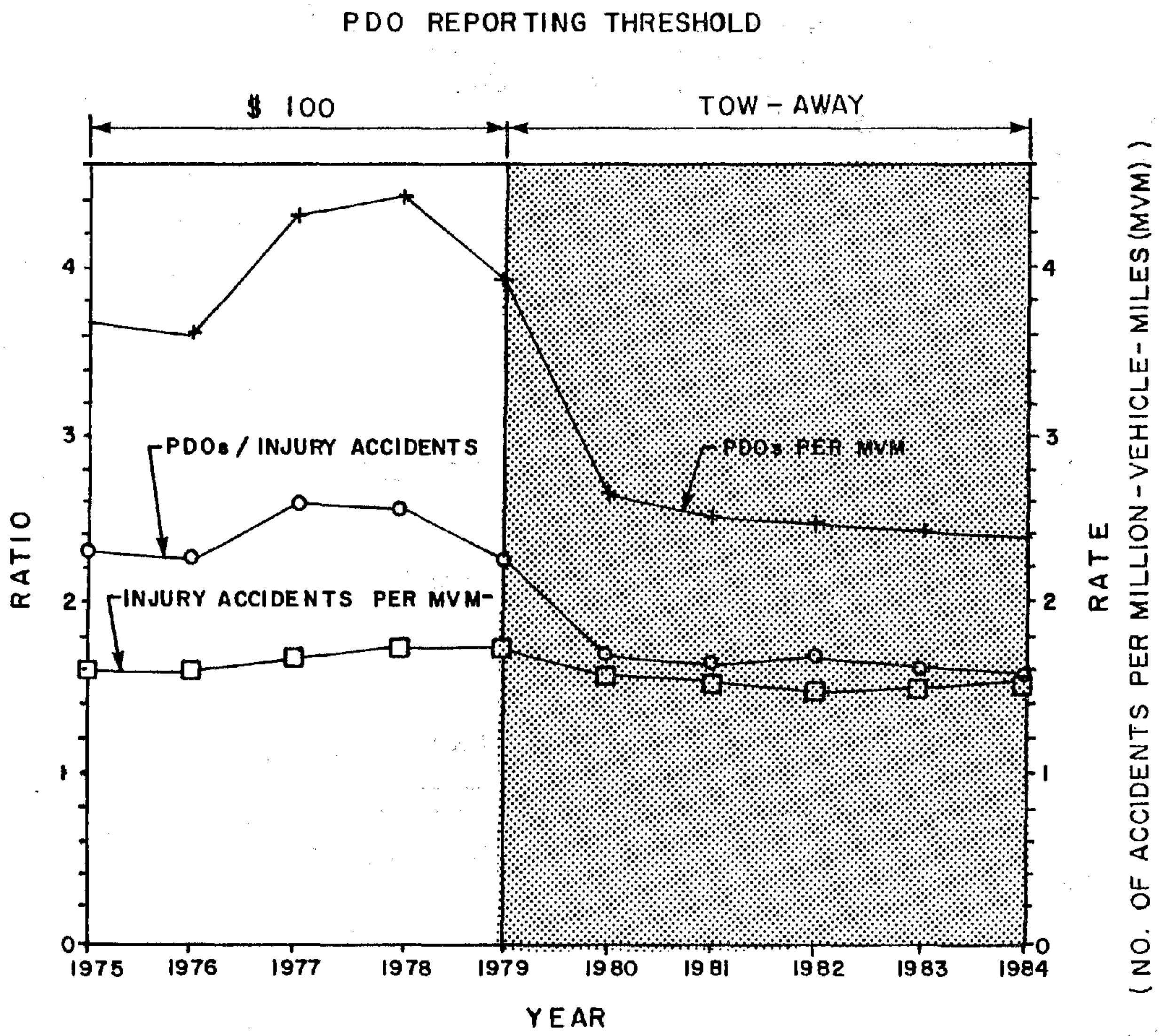


Figure 14. Summary of Maryland's traffic accident data

Procedures for processing PDOs in New York State are unique. Section 605 of the New York Vehicle and Traffic Law requires that accidents resulting in death, personal injury, or property damage in excess of $600 must be reported by drivers to the New York Department of Motor Vehicles (DMV). Although the police are not required by law to report PDO accidents, they do report those that they investigate. When they report PDOs, police do not include an estimate of the amount of property damage. Ideally, the amount of property damage is reported by drivers and the driver and police reports are used together in creating the computerized record of each accident. However, many PDO accidents are reported by police but not by the motorists involved; in addition, many drivers fail to report the amount of property damage or report amounts less than $600. In these cases, the accidents are classified by NYDMV as "nonreportable" PDOs. This practice causes substantial undercounting of reportable PDOs because those which are not reported correctly are called "nonreportable". The NYDMV does not discard the data for the "nonreportable" accidents. The accident number, date and location of "nonreportable" accidents are entered by DMV in its computerized accident file and copies of the full reports are forwarded to the Department of Transportation (NYDOT) along with the computerized data for use in support of highway safety programs.

Figures 15 and 16 illustrate trends in the reporting of "reportable" and "nonreportable" PDOs in New York over the past decade. Those shown as "reportable" cover only the reportable PDOs which have been properly reported by the driver. The number of "nonreportable" PDOs has been increasing throughout this period at an increasing rate. The number of police-reported "reportable" accidents, for each of which a driver has reported the amount of property damage, has remained quite stable at about 50,000 per year since 1976. The number of "reportable" accidents reported properly by drivers, but not reported by police, dropped from about 140,000 in 1976 to about 50,000 in 1981 and has increased slightly since then. In 1981, the number of "nonreportable" PDO's was more than three times the number of "reportable" PDOs.

The New York accident data trends shown in figures 17 and 18 do not include "nonreportable" PDOs. The ratio of PDOs to injury accidents has declined from about 1.0 in 1975 to about 0.6 in 1985. However, because the NYDOT uses the reports of "nonreportable" PDOs, the effective ratio has been above 2 for years for those engaged in development and evaluation of NYDOT safety programs. Changes in the New York procedures for handling "nonreportable" PDOs are under consideration by the NYDMV in cooperation with the NYDOT.

Underreporting of PDOs has been a matter of concern among safety professionals at all government levels for several years. As is evident from the data above, the situation varies considerably from State to State. Illinois, for example, appears

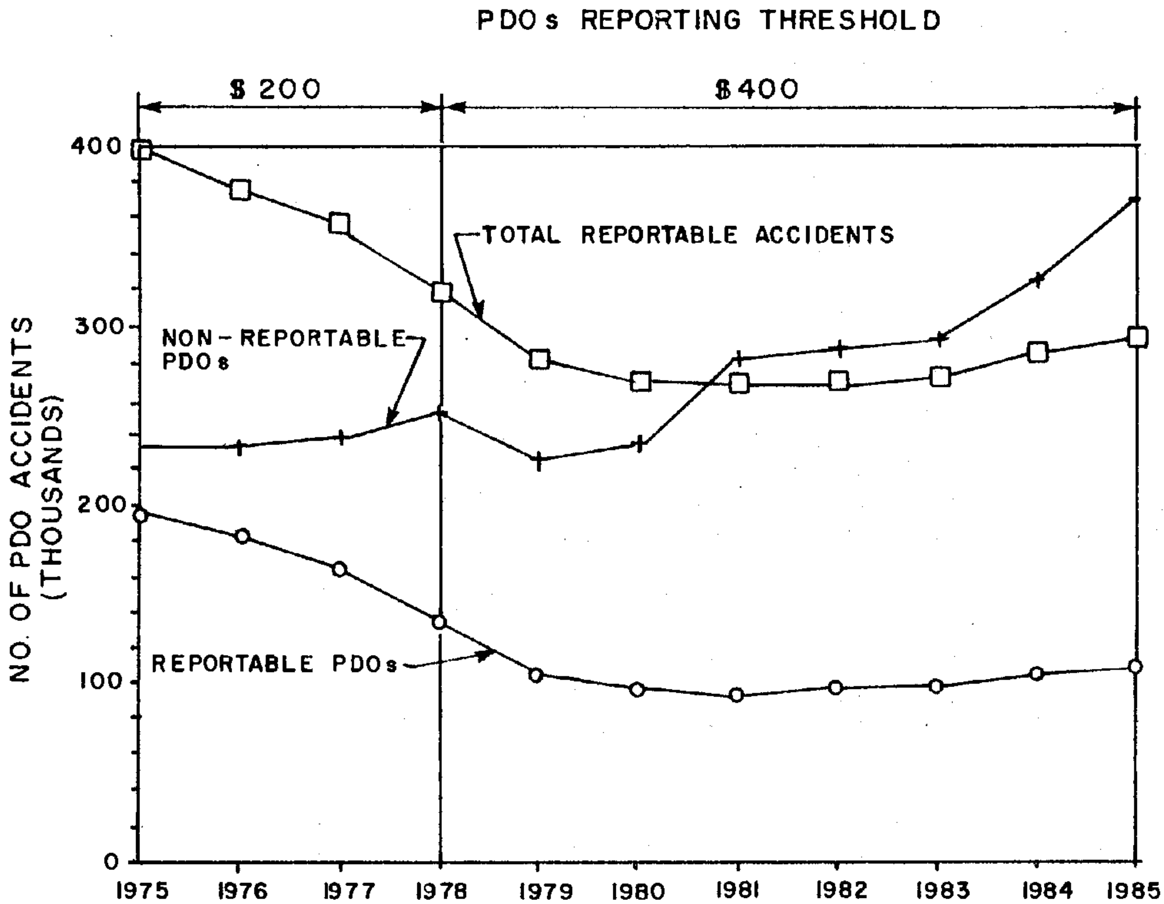


Figure 15. Summary of reportable and nonreportable PDOs in New York

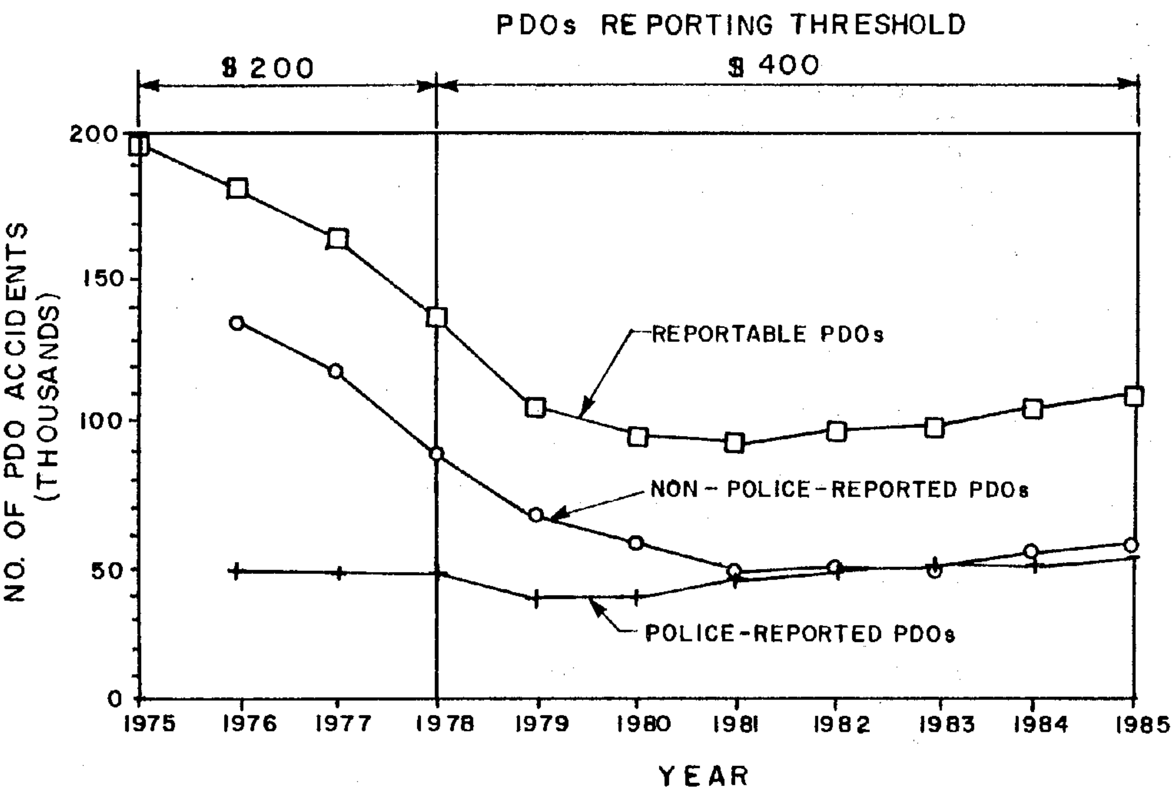


Figure 16. Summary of police/nonpolice reported PDOs in New York

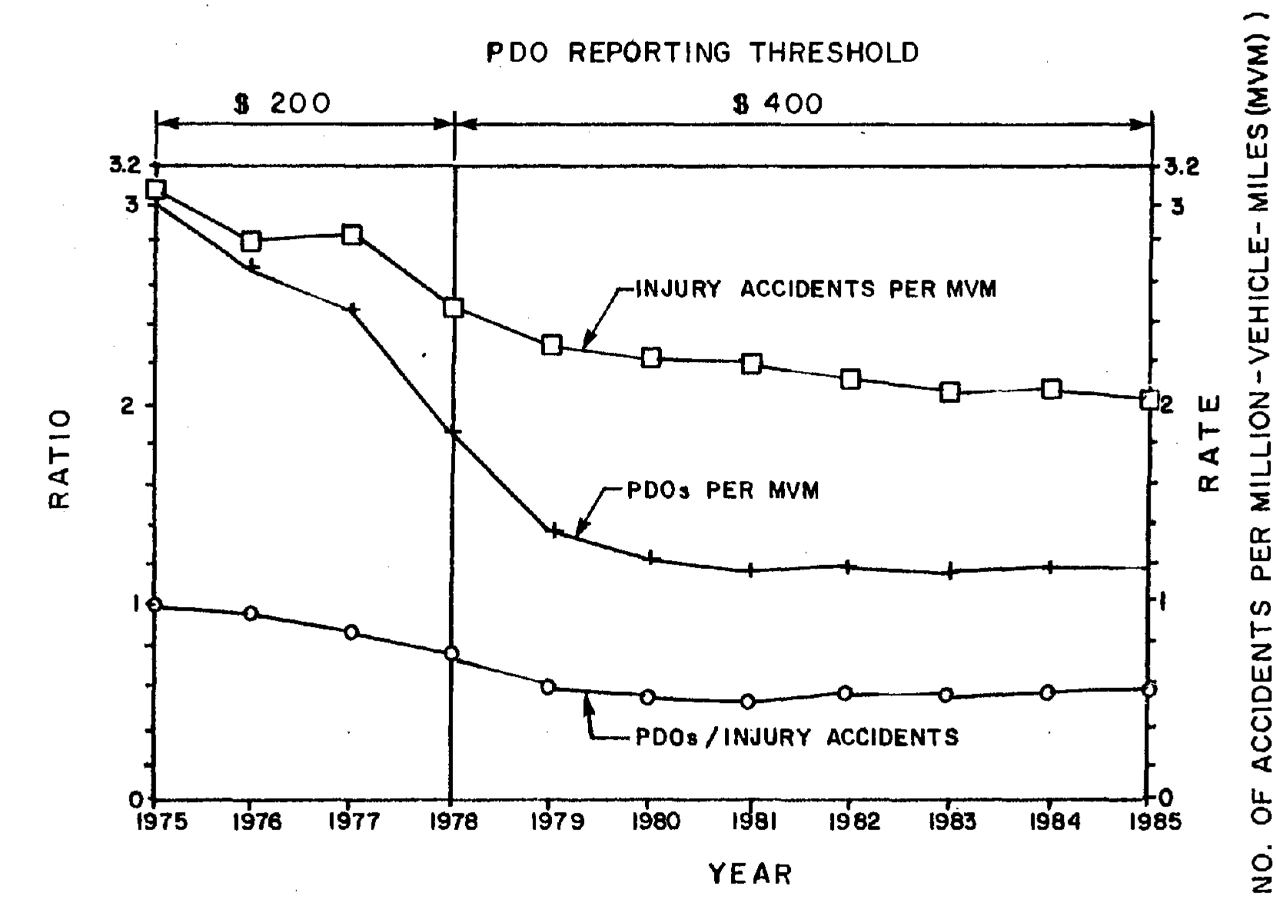


Figure 17. Summary of New York's traffic accident data

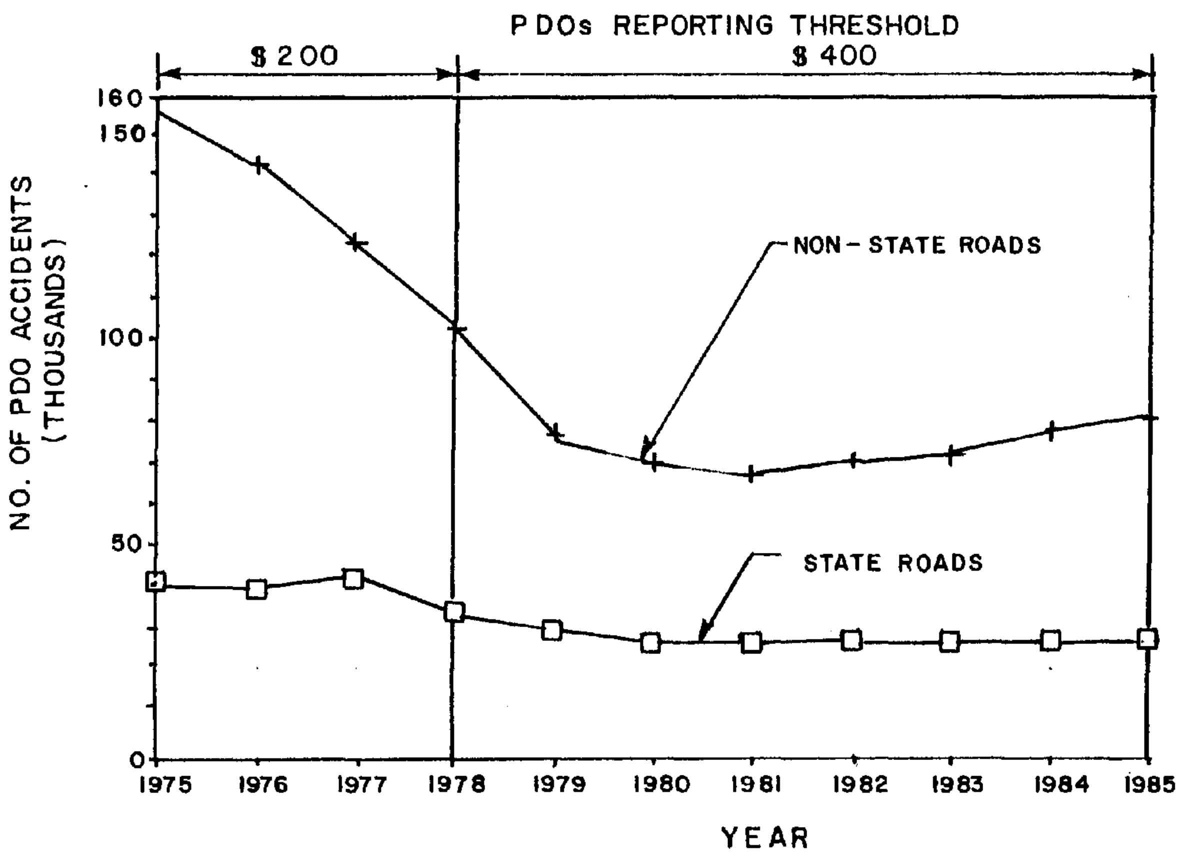


Figure 18. Summary of State and non-State PDOs in New York

to have a very satisfactory level of PDO reporting. In Florida, where the State Department of Transportation objected strongly to conversion to a tow-away threshold for PDO reporting, highway engineers are finding that a tow-away threshold for PDO reporting does not provide adequate support for State traffic safety programs. Generally, the ratios of PDOs to injury accidents and other information indicates that sufficient PDO data is being collected in most States to provide the support that is needed for most highway safety programs. In some States, such as California, these data are being used at the local level but are not getting into the State traffic records system.

In many cities, local police reporting practices are determined by perceived local needs. The threshold level for police reporting of PDOs in California, for example, varies considerably among counties and cities. The State obligates drivers to report PDOs if property damage is $500 or more but does not require police reports of PDOs. Police in Los Angeles use a $200 reporting threshold level. In contrast, San Francisco police do not investigate or report noninjury accidents except for tow-away PDOs. The California Highway Patrol has been collecting and processing police reports of PDOs from local jurisdictions who are willing to submit them but, because of the highly variable levels of PDO reporting and transmittal, has considered omitting PDO data from the State accident data base.

In 1983, the Institute of Transportation Engineers (ITE) conducted a nationwide survey of State highway agencies to determine if police reporting of motor vehicle accidents, and particularly PDOs, had degraded throughout the country. (10) The ITE found that the level of PDO reporting had been reduced in over one-third of the States. (10,18) Nevertheless, a majority of respondents from States with reduced reporting maintained that they were able to identify hazardous locations, determine accident patterns, and justify safety improvements. There appeared to be unanimous agreement among highway agencies, however, that steps should be taken to ensure the availability of an adequate amount of traffic accident data.

In conclusion, the most suitable threshold for PDO reporting appears to be a dollar threshold which produces an average of 2 to 3 PDOs for each injury accident. The tow-away threshold for PDO reporting is not generally acceptable to highway engineers because the greatly reduced number of reported PDOs substantially weakens their capacity to identify site-specific hazards and to evaluate safety improvements at hazardous locations.

Short Forms for Reporting PDO Accidents

One method for reducing the accident reporting burden on police, as well as the cost of data processing, is the use of short forms for PDOs. Short forms are simplified versions of regular accident report forms. In 1983, according to ITE, at least eight States were using short forms for reporting of PDO accidents. (10)

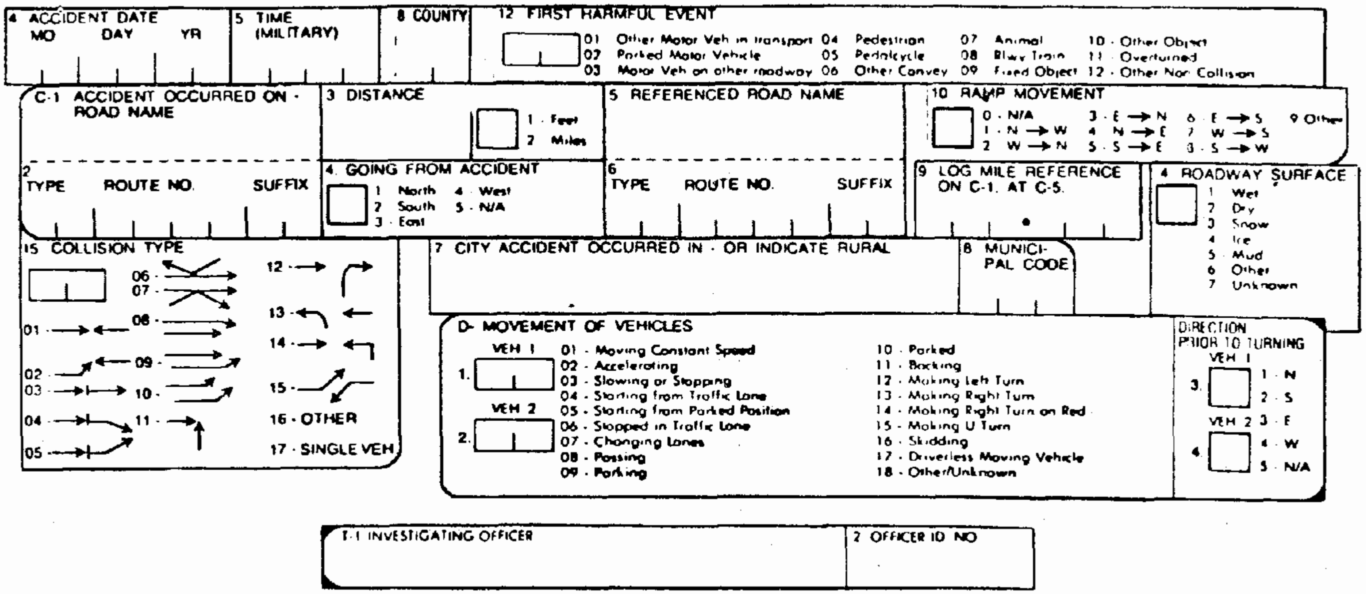
In 1979, when the Maryland State Police (MSP) decided to stop reporting nontow-away PDOs, the Maryland State Highway Department (MSHD) tried vigorously to convince the MSP that PDO data were needed. They proposed the use of a short form as a compromise between full reporting of nontow-away PDOs and no reports at all. A short form shown in figure 19, was developed and tested in the early 1980's; results were encouraging. The Baltimore County Police Department indicated that completion of the form, including the review and processing time, ranged from six to sixteen minutes. However, the police claimed that the short form did not result in any meaningful time savings. Most police time at accidents is associated with travel to the accident scene, checking driver licenses and vehicle registrations, issuing citations, and making the roadway safe for traffic. Hence, the use of a short form instead of a regular form would save substantially less police time than is saved if police do not go to the site of nontow-away accidents. The MSHD was unable to convince the MSP that short forms were a viable alternative to adoption of a tow-away PDO reporting threshold.

In Delaware, where short forms are in use, highway engineers compensate for the reduced amount of information by sending multidisciplinary teams to inspect locations where safety improvements have been proposed.

As part of its effort to reverse a decline in PDO reporting, Missouri introduced a short form for reporting PDO accidents in 1983. The form was designed with input from State and local police and highway officials. Since the short form was adopted, the level of cooperation in reporting PDOs has been excellent.

Arizona uses a short form in a multilevel reporting operation. The report consists of one page (4 1/4 in. by 9 in.) with carbons for reporting PDOs; one partial copy is given to each involved driver as evidence of the accident and for use in submitting insurance; a third and more comprehensive page is forwarded for entry into the State accident data file. A copy of the driver page of the report is shown in figure 20. Figure 21 shows a copy of the comprehensive page. Although the short form appears to have been widely accepted in Arizona, it may be phased out soon. Highway officials in Arizona indicated that the inconvenient size of the form creates filing difficulties and that its use has been abused by some local police departments who use it to report injury accidents.

Although there is some shared information about the structure of short forms, there is little uniformity or agreement on which data elements should be retained when data elements on the regular form are eliminated. The short form developed by the MHSD (figure 19), for example, lacks data elements that many users would consider to be essential. Therefore, while the



4 ACCIDENT DATE MO DAY YR
5 TIME (MILITARY)
8 COUNTY
12 FIRST HARMFUL EVENT
01 Other Motor Veh in transport 04 Pedestrian 07 Animal 10 - Other Object
02 Parked Motor Vehicle 05 Pedalcycle 08 Rlwy Train 11 - Overturned
03 Motor Veh on other roadway 06 Other Convey 09 Fixed Object 12 - Other Non Collision
C-1 ACCIDENT OCCURRED ON - ROAD NAME
3 DISTANCE 1 - Feet 2 - Miles
5 REFERENCED ROAD NAME
10 RAMP MOVEMENT
0 - N/A 1 - N → W 2 W → N 3 - E → N 4 N → E 5 - S → E 6 - E → S 7 W → S 8 - S → W 9 Other
2 TYPE ROUTE NO. SUFFIX
4. GOING FROM ACCIDENT
1 North 2 South 3 - East 4 - West 5 - N/A
6 TYPE ROUTE NO. SUFFIX
9 LOG MILE REFERENCE ON C-1, AT C-5
4 ROADWAY SURFACE
1 Wet 2 Dry 3 Snow 4 Ice 5 Mud 6 Other 7 Unknown
15 COLLISION TYPE
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15
16 - OTHER
17 - SINGLE VEH
7 CITY ACCIDENT OCCURRED IN - OR INDICATE RURAL
8 MUNICIPAL CODE
D- MOVEMENT OF VEHICLES
VEH 1 VEH 2
01 - Moving Constant Speed
02 - Accelerating
03 - Slowing or Stopping
04 - Starting from Traffic Lane
05 - Starting from Parked Position
06 - Stopped in Traffic Lane
07 - Changing Lanes
08 - Passing
09 - Parking
10 - Parked
11 - Backing
12 - Making Left Turn
13 - Making Right Turn
14 - Making Right Turn on Red
15 - Making U Turn
16 - Skidding
17 - Driverless Moving Vehicle
18 - Other/Unknown
DIRECTION PRIOR TO TURNING
VEH 1 VEH 2
1 - N 2 - S 3 - E 4 - W 5 - N/A
T-1 INVESTIGATING OFFICER
2 OFFICER ID NO

Figure 19. Maryland's proposed traffic accident short-form report

01-8306 11/80

ARIZONA DEPARTMENT OF TRANSPORTATION

TRAFFIC ACCIDENT REPORT

SHORT FORM

☐ INCIDENT ☐ ACCIDENT ☐ PRIVATE PROPERTY | DR#

YEAR | MONTH | DAY | HOUR | NCIC | OFFICER ID NBR | DAY **01**

UNITS **0000211** | DIST/AREA

LOC: ON | ☐ IN ☐ OUT | CITY

INTERSECTING STREET/MILEPOST | COUNTY

☐ NORTH ☐ SOUTH | ☐ EAST ☐ WEST | ☐ PLUS ☐ MINUS | DISTANCE | ☐ MILES ☐ FEET

VEH # **01** | STATE | CLASS | LICENSE OR SOC. SEC NBR. | SEX | INJ **1** | REST | DOB

DRIVER NAME

ADDRESS | CITY | STATE

PLATE | STATE | YEAR | COLOR | YEAR | MAKE | ☐ CAMPER

☐ SAME AS DRIVER | OWNER'S NAME | CITY | STATE

BODY | VIN | POSTED SP | OFF EST | R & P SPEED | DRIV EST

TRL (OTHER UNIT) PLATE | STATE | YEAR | DESCRIBE TRL OR OTHER UNIT

VEH # **02** | STATE | CLASS | LICENSE OR SOC. SEC. NBR. | SEX | INJ. **1** | REST | DOB

DRIVER NAME

ADDRESS | CITY | STATE

PLATE | STATE | YEAR | COLOR | YEAR | MAKE | ☐ CAMPER

☐ SAME AS DRIVER | OWNER'S NAME | CITY | STATE

BODY | VIN | POSTED SP | OFF EST | R & P SPEED | DRIV EST

TRL (OTHER UNIT) PLATE | STATE | YEAR | DESCRIBE TRL OR OTHER UNIT

ARREST: NAME | CHARGE

NAME | CHARGE

NARRATIVE

WITNESS(ES):

INVESTIGATE AT SCENE ☐ YES ☐ NO

DATE INVEST. | TIME INVEST

OFFICER NAME (PRINT)

Figure 20. Arizona's traffic accident short-form report (driver's copy)

15-CLASSIFICATION BY TYPE

YES NO
[ ] [ ] RAN OFF ROADWAY PRIOR TO FIRST HARMFUL EVENT

COLLISION BETWEEN A MOTOR VEHICLE IN TRANSPORT AND
1 [ ] PEDESTRIAN
2 [ ] MOTOR VEHICLE
3 [ ] RAILWAY TRAIN
4 [ ] PEDALCYCLIST
5 [ ] ANIMAL
6 [ ] FIXED OBJECT
7 [ ] OTHER OBJECT

NONCOLLISION INVOLVING A MOTOR VEHICLE IN TRANSPORT
8 [ ] OVERTURNING
9 [ ] OTHER NONCOLLISION

16-LIGHT CONDITION

CHECK ONLY ONE
1 [ ] DAYLIGHT
2 [ ] DAWN OR DUSK
3 [ ] DARKNESS

YES NO
1 [ ] [ ] STREET LIGHT
2 [ ] [ ] STREET LIGHT FUNCTIONING

17-WEATHER CONDITIONS

CHECK ONLY ONE
1 [ ] CLEAR
2 [ ] RAINING
3 [ ] CLOUDY
4 [ ] SNOWING
5 [ ] STRONG WIND
6 [ ] DUST
7 [ ] FOG

18-ROAD SURFACE TYPE

CHECK ONLY ONE
1 [ ] ASPHALT
2 [ ] CONCRETE
3 [ ] GRAVEL
4 [ ] DIRT
5 [ ] OTHER

19-TYPE OF LOCATION

CHECK ONLY ONE
1 [ ] INTERSECTION
2 [ ] JUNCTION AREA
3 [ ] NON-JUNCTION AREA
4 [ ] DRIVEWAY ACCESS
5 [ ] ALLEY ACCESS

20-INTERSECTION RELATED

[ ] YES [ ] NO

21-SPECIAL LOCATION

CHECK ONLY ONE
1 [ ] SCHOOL CROSSING
2 [ ] PEDESTRIAN CROSSWALK (STRIPED)
3 [ ] PEDESTRIAN CROSSWALK (NO STRIPING)
4 [ ] BRIDGE
5 [ ] TUNNEL
6 [ ] R.R. CROSSING
7 [ ] ALLEY
8 [ ] BIKE PATH
9 [ ] 2-WAY LEFT TURN LANE

22-UNUSUAL ROAD CONDITION

CHECK ONLY ONE
1 [ ] UNDER CONSTRUCTION, TRAFFIC ALLOWED
2 [ ] UNDER CONSTRUCTION, NO TRAFFIC ALLOWED
3 [ ] UNDER REPAIRS
4 [ ] HOLES, RUTS, BUMPS
5 [ ] OBSTRUCTION - PROTECTED
6 [ ] OBSTRUCTION - UNPROTECTED
7 [ ] OBSTRUCTION - UNLIGHTED AT NIGHT
8 [ ] DEFECTIVE SHOULDERS
9 [ ] CHANGING ROAD WIDTH
10 [ ] FLOODED
11 [ ] TEMPORARY LANE CLOSURE

23-TRAFFIC CONTROL DEVICES

LEGEND: A- DEVICE PRESENT
B- DAMAGED OR NON-FUNCTIONAL PRIOR TO ACCIDENT

CHECK ANY THAT APPLY
A B
1 [ ] [ ] STOP AND GO SIGNAL
2 [ ] [ ] YIELD SIGN
3 [ ] [ ] STOP SIGN
4 [ ] [ ] WARNING SIGN
5 [ ] [ ] RAILROAD SIGNAL
6 [ ] [ ] FLASHING SIGNAL
7 [ ] [ ] FLAGMAN OR OFFICER

24-NON-INTERSECTION ROAD CHARACTER

CHECK ONLY ONE
1 [ ] 2-WAY STRIPED CENTERLINE
2 [ ] 2-WAY, NO STRIPE
3 [ ] 2-WAY, PAINTED MEDIAN
4 [ ] 2-WAY, RAISED MEDIAN
5 [ ] 2-WAY, BARRIER MEDIAN
6 [ ] 2-WAY, DEPRESSED MEDIAN
7 [ ] 2-WAY, EXTENDED MEDIAN
8 [ ] 1-WAY STREET

25-ROAD GRADE

CHECK ONLY ONE
1 [ ] LEVEL
2 [ ] DOWNGRADE
3 [ ] UPGRADE
4 [ ] HILLCREST
5 [ ] DIP

26-UNUSUAL ROAD SURFACE CONDITION

CHECK ONLY ONE
1 [ ] WET
2 [ ] LOOSE SAND, DIRT OR GRAVEL
3 [ ] SNOWY / ICY
4 [ ] FRESH OIL
5 [ ] OTHER
6 [ ] UNKNOWN

27-PHYSICAL CONDITION

TWO CHOICES PER PERSON MAY BE SELECTED
1 2
1 [ ] [ ] NO APPARENT DEFECTS
2 [ ] [ ] HAD BEEN DRINKING
3 [ ] [ ] APPEARED TO BE UNDER INFLUENCE OF DRUGS
4 [ ] [ ] ILL-ABILITY INFLUENCED
5 [ ] [ ] SLEEPY - FATIGUED
6 [ ] [ ] OTHER BODILY DEFECTS, INFIRMITIES
7 [ ] [ ] UNKNOWN

28-VIOLATIONS/BEHAVIOR

TWO CHOICES PER PERSON MAY BE SELECTED
1 2
1 [ ] [ ] NO IMPROPER DRIVING
2 [ ] [ ] SPEED TOO FAST FOR CONDITIONS
3 [ ] [ ] EXCEEDED LAWFUL SPEED
4 [ ] [ ] FAILED TO YIELD RIGHT-OF-WAY
5 [ ] [ ] FOLLOWING TOO CLOSELY
6 [ ] [ ] RAN STOP SIGN
7 [ ] [ ] DISREGARDED TRAFFIC SIGNAL
8 [ ] [ ] MADE IMPROPER TURN
9 [ ] [ ] DROVE IN OPPOSING TRAFFIC LANE
10 [ ] [ ] KNOWINGLY OPERATED WITH FAULTY OR MISSING EQUIPMENT
11 [ ] [ ] REQUIRED MOTORCYCLE SAFETY EQUIPMENT NOT USED
12 [ ] [ ] PASSED IN NO PASSING ZONE
13 [ ] [ ] UNSAFE LANE CHANGE
14 [ ] [ ] OTHER UNSAFE PASSING
15 [ ] [ ] INATTENTION
16 [ ] [ ] DID NOT USE CROSSWALK
17 [ ] [ ] WALKED ON WRONG SIDE OF ROAD
18 [ ] [ ] OTHER
19 [ ] [ ] UNKNOWN

29-VEHICLE CONDITION

TWO CHOICES PER VEHICLE MAY BE SELECTED
1 2
1 [ ] [ ] NO APPARENT DEFECTS
2 [ ] [ ] DEFECTIVE BRAKES
3 [ ] [ ] DEFECTIVE STEERING
4 [ ] [ ] DEFECTIVE HEADLIGHTS
5 [ ] [ ] DEFECTIVE TAIL LIGHTS
6 [ ] [ ] DEFECTIVE TURN-SIGNAL
7 [ ] [ ] PUNCTURE OR BLOWOUT
8 [ ] [ ] ONE OR MORE SMOOTH TIRES
9 [ ] [ ] FIRE
10 [ ] [ ] DEFECTIVE WINDSHIELD/WIPER
11 [ ] [ ] DEFECTIVE EXHAUST SYSTEM
12 [ ] [ ] OTHER DEFECTS
13 [ ] [ ] NO TRAILER BRAKES
14 [ ] [ ] UNKNOWN

30-TRAFFIC UNIT ACTION

CHECK ONE PER UNIT
1 2
1 [ ] [ ] GOING STRAIGHT AHEAD
2 [ ] [ ] SLOWING IN TRAFFICWAY
3 [ ] [ ] STOPPED IN TRAFFICWAY
4 [ ] [ ] MAKING LEFT TURN
5 [ ] [ ] MAKING RIGHT TURN
6 [ ] [ ] MAKING U TURN
7 [ ] [ ] ENTERING ALLEY OR DRIVEWAY
8 [ ] [ ] LEAVING ALLEY OR DRIVEWAY
9 [ ] [ ] OVERTAKING/PASSING
10 [ ] [ ] CHANGING LANES
11 [ ] [ ] BACKING
12 [ ] [ ] AVOIDING VEHICLE, OBJECT, PEDESTRIAN
13 [ ] [ ] ENTERING PARKING POSITION
14 [ ] [ ] LEAVING PARKING POSITION
15 [ ] [ ] PROPERLY PARKED
16 [ ] [ ] IMPROPERLY PARKED
17 [ ] [ ] DRIVERLESS MOVING VEHICLE
18 [ ] [ ] CROSSING ROAD
19 [ ] [ ] WALKING WITH TRAFFIC
20 [ ] [ ] WALKING AGAINST TRAFFIC
21 [ ] [ ] STANDING
22 [ ] [ ] LYING
23 [ ] [ ] GETTING ON OR OFF VEHICLE
24 [ ] [ ] WORKING ON OR PUSHING VEHICLE
25 [ ] [ ] WORKING ON ROAD
26 [ ] [ ] OTHER
27 [ ] [ ] UNKNOWN

31-VISION OBSCUREMENT

CHECK ONE PER UNIT
1 2
1 [ ] [ ] NOT OBSCURED
2 [ ] [ ] BY PARKED/STOPPED VEHICLE
3 [ ] [ ] BY MOVING VEHICLE
4 [ ] [ ] BY BUILDING
5 [ ] [ ] BY EMBANKMENT
6 [ ] [ ] BY SIGNBOARD
7 [ ] [ ] BY HILLCREST
8 [ ] [ ] BY LOAD ON VEHICLE
9 [ ] [ ] BY TREES, BUSHES
10 [ ] [ ] BY HEADLIGHT
11 [ ] [ ] BY SUN GLARE
12 [ ] [ ] BECAUSE OF BAD WEATHER
13 [ ] [ ] OTHER
14 [ ] [ ] RAIN, SNOW, FOG ON WINDSHIELD
15 [ ] [ ] WINDSHIELD OBSCURED - OTHER
16 [ ] [ ] UNKNOWN

32-SKIDDING OCCURRED

YES NO
[ ] [ ] VEHICLE 1
[ ] [ ] VEHICLE 2

REPORT CHECKED BY ____________ BADGE # ________

DATE ____________

Figure 21. Arizona's traffic accident short-form report (police - partial copy)

quantity of accident reports might increase if such a form is used, the form may lack data elements essential to the identification of hazardous locations, the selection of countermeasures, and the evaluation of specific safety projects. Clearly, the use of short forms by the police has not been widely accepted as a satisfactory method to cut the costs of collecting and processing PDO data.

Administrative Considerations

The primary administrative problem affecting the level of police accident reporting is the tightening of police agency budgets. When funding is tight, priorities have to be established. In many police agencies, accident reporting does not have a high priority. Closely related to the shortage of funds is the shortage of staff. Even when police consider traffic accident reporting to be an important part of their work, police are not always available to investigate accidents. It was largely a shortage of manpower that led police officers in Prince George's County and Montgomery County in Maryland to stop reporting nontow-away PDOs in 1979. Since then, several other counties in Maryland and the City of Baltimore have significantly reduced their accident reporting efforts. In Missouri, accident reporting gets more attention from State police because the State Highway Commission, the major user of accident reports, controls the budget of the State Police Department.

Regardless of the size of an agency, commitment by top management in conjunction with effective management practices can go a long way toward promoting improved accident reporting. For example, Illinois DOT personnel have cited the importance of good communications between data collectors and data users in addition to a management commitment to safety. A Highway Safety Improvement Committee at the central office was mentioned as an indication of the high level of State support for safety programs.

Supplementary Accident Reporting by Drivers

There is only one widely accepted exception to highway engineering dependence on police reports for accident data used in routine administration of safety programs. That exception is the use of accident data submitted by drivers to supplement police-reported data. Of the States visited by the study team four (California, Florida, Illinois and New York) use driver accident reports as a secondary source of accident data. In spite of the potential for bias, where the number of PDOs reported by police alone does not adequately meet the needs of data users of jurisdictions, driver-reported data can enhance the accident data base.

State rules for driver reporting vary widely. Arizona drivers are not required to report any PDOs. Illinois drivers have been required for many years to report all accidents involving personal injuries or property damage of $250 or more. Although dollar reporting thresholds differ, similar reporting policies exist in California, New York, and several other States. These policies encourage involved drivers to report traffic accidents to avoid penalties.

In Illinois, State law requires that reports of all accidents investigated by law enforcement agencies be forwarded to the DOT. Chicago's current PDO reporting procedures, which have a substantial impact on the Illinois accident data base, require motorists to go to police stations and fill out desk reports in lieu of accident investigations and reports by police for most PDOs. This tends to reduce the number of reported PDOs because drivers reluctant to have accidents on their records often fail to report.

Section 605 of the Vehicle and Traffic Law of New York requires drivers to report accidents resulting in death, personal injury, or property damage in excess of $600 to the New York Department of Motor Vehicles. These reports are the only source of property damage estimates; the police do not estimate property damage for any accidents. New York State Police are not required to report PDO accidents but do report some. Injury data reported by drivers are used in the accident data files in preference to that reported by police.

When police do not get to the scene of an accident in Pennsylvania, drivers are required to appear in person at a police station to make a report.

Increased automobile insurance premiums have tended to keep drivers from reporting minor PDO accidents. There is little incentive to report an accident if the premium increase may be higher than the cost of repairs. The adoption of no-fault insurance in some jurisdictions has reduced the incentive to overstate injuries and property damage in the hope of obtaining a large award from an insurance company.

Two factors tend to discourage the use of driver reports. First, it has been a time consuming and labor-intensive procedure to match each driver report with the police report, if any, for the same accident. In large States, this involves hundreds of thousands of reports. In the future, computer sorting techniques together with digital image recording of the accidents reports may reduce the cost of this operation. Second, the quality of driver-reported data may tend to be low because of inherent bias and failure to interpret the questions on the form correctly. Careful form design can reduce this problem. Perhaps the most difficult data to collect are accurate accident location descriptions; without these, the reports have little value for many engineering applications.

Driver reports raise concerns about the deliberate misrepresentation of accident facts and the need for drivers to have a high degree of literacy. These issues influenced early efforts to improve the quality of accident data, causing greater emphasis to be placed on police reports. However, The value of driver reports has increased in those jurisdictions which have experienced reduced police reporting. Driver reports may be particularly valuable in jurisdictions which have adopted the tow-away criterion for noninjury accidents. Today, the driver population is an underutilized source for reporting noninjury accidents. While the potential for biased reporting may continue to be an issue, researchers have not adequately considered driver psychology in designing accident report forms that decrease the opportunity to distort accident facts. Current practices in driver reporting can serve as the foundation for further studies to determine the format and content of driver reports which will ensure improved reliability.

Driver reports still provide a viable source for accident information in several States. The use of data submitted by drivers appears to be the best available method to expand State accident data bases beyond the level reported by police.

Police Training

State highway officials interviewed for this study recognize the need for monitoring and improving the accuracy of data in the various safety information files. They noted that the report preparation and data entry steps are particularly prone to errors. The magnitude of the problem correlates inversely to the amount of effort and resources directed at training police officers to prepare accident reports and at feedback on problems with submitted data. Jurisdictions which have invested in programs to encourage accurate recording and in strategies for maintaining police awareness are more satisfied with the quality of the information in their data bases. Most of the States visited claim to have fairly accurate accident data for State administered facilities, primarily because of superior reporting by the State highway patrol. State officials often mentioned their concern about the quality and availability of data from local jurisdictions.

Based on the visits by the study team and the findings of Turner, it seems clear that many law enforcement personnel do not understand how accident data are used to make traffic engineering decisions and, therefore, do not gather the data with such uses in mind. (33) In addition, turnover among police officers at the local level is a problem.

The quality of data entered on police accident reports has improved significantly in States offering training courses in accident reporting. Training is a relatively inexpensive way to improve the quality of police accident reporting -- especially where the quality is initially quite low. Many States routinely provide such training; others are considering it.

A modest involvement of highway departments in police training courses can pay off handsomely in reducing the amount of accident report editing. It appears that the most effective training programs are those where there is personal interaction between highway agency personnel and police officers, with opportunities for questions and discussion. "Canned" programs such as videos or slide-tapes apparently are not effective in achieving desired results. Personal contact at the training courses between police and those who process and use their data contributes significantly to the value of the training. Although newsletters dealing with problems and common errors in accident reporting can be effective, they are probably not as good an investment as training courses which provide for personal interaction.

Errors and miscoded information were reported in all the States visited, with some States reporting more problems than others. Arizona, for example, has no formal accident report training program for police agencies. Two States expressed dissatisfaction with the police officer training received at their police academies. One highway agency official noted that police academy instructors were "ill-prepared to deal with the fundamentals of accident information." On the other hand, those agencies that were generally satisfied with accident reporting made a concerted effort to train and communicate with law enforcement personnel.

In 1983, having recognized that the quantity and quality of accident data was deteriorating, a committee was set up in Missouri to review reporting problems. Representatives from the Highway Commission and the State and local police participated. The committee developed a short form for accident reports and an accident reporting course for police at Central Missouri State College. Since then, the level of cooperation in reporting PDO accidents has been excellent. Missouri officials indicated that no substantial reduction in the level of PDO accident reporting has been observed since 1983.

The Illinois DOT created a Local Liaison Unit (LLU) within its Division of Traffic Safety to foster continued cooperation among officials involved in gathering, using, and managing traffic accident data. Functions of the LLU include maintaining liaison with local police and local engineering personnel, providing instruction to local police agencies on accident reporting through seminars and annual meetings, coordinating with the Illinois State Police training programs, and informing police agencies of available Federal highway safety funds. All 1200 police agencies in Illinois were contacted by the LLU within the last two years. Several of the Illinois DOT traffic and safety personnel are members of the International Association of Chiefs of Police and attend their meetings on a regular basis, thus promoting good working relationships.

Pennsylvania DOT's Center for Highway Safety, which receives and processes police accident reports, conducts seminars on accident reporting and investigation. These seminars have been available for the past seven years and are aimed at the 1300 local police departments. A quarterly newsletter provides the medium for a continuing dialogue on accident reporting issues. The seminars have contributed significantly to the quality of police-reported data in Pennsylvania but their frequency has been limited by a shortage of personnel to conduct them.

New York formerly used a combination of training courses on police accident reporting and a periodic newsletter to help maintain the quality of police accident reports. After both were discontinued due to funding cuts, a decline in the quality of accident reports became apparent.

The Florida DOT conducts training seminars and credit courses during a seven week period at the Police Academy. These courses cover several aspects of traffic safety and accident investigation and are used by the police as the basis for promotion.

State and local police departments should require training in accident reporting as part of their continuing training programs. Such training should not only cover the information collection and recording process but should also establish an awareness of the importance of accurate reporting, the needs of diverse user agencies, the use of the data in highway safety and law enforcement, the consequences of data deficiencies, and the cost of accidents to society. State highway departments and other agencies which receive and use police data should participate in this training; police reporting tends to improve markedly when the police know why the data are needed. High-level State and local officials should promote effective coordination among agencies involved in collecting, processing, and use of accident and related data. The formation of inter-agency liaison committees has been found to be an effective way to promote coordination of training and other methods to improve accident data in a number of States.

Reporting of Accident Locations

Accurate determination of accident location is essential in any highway information system. Without accurate location reference data, it is impossible to identify hazardous highway segments and the features that create the hazards. As a result of State recognition of the need for accurate location data and the availability of Federal-aid safety and planning funds to help meet this need, all States have developed some type of highway location reference system. FHWA's 1987 report on safety programs indicated that all States and the District of Columbia have developed reference systems covering their entire State-administered highway systems. (36) Thirty States have developed a reference system covering locally-administered highway systems, as well. In 22 States, however, reference systems for local roads were incomplete or nonexistent.

Accident location reference data are needed to permit merging of accident, traffic, and roadway data so that high-accident locations and elements can be identified and analyzed. Since the emphasis on accident information systems increased in the mid 1960's, highway agencies have been studying the problem of how to obtain accurate accident location data. In his 1972 report on the state-of-the-art of highway location reference systems, William T. Baker pointed out that, although, to the casual user of highway reference methods, there appear to be many widely different methods in use, all are fundamentally the same. (12) The use of different terms to describe similar applications has contributed to the confusion. Terms such as straight-line diagram, route log, coordinates, milepost, and reference post have been used very loosely. Regardless of the names assigned to current methods for referencing highway locations, all use distances and directions from known points to describe locations.

It became clear from discussions with State and local officials in this study that erroneous location data remain an important concern among highway agencies. A particularly troublesome problem is the reporting of roughly estimated -- rather than measured -- distances from known reference points to points of interest such as accident sites. The errors in such estimates are sometimes substantial. There is need for highway location referencing systems which are less vulnerable to human errors yet which do not unduly increase the burden on reporting officers. Innovations in computer, satellite, and pavement sensor technologies may be the key to future highway location referencing systems.

The nine States visited in this study indicated that the accuracy of location information coded by police agencies was questionable. Missouri officials noted that most of their data problems were related to location. In Pennsylvania, errors in location data were the biggest problem in editing accident reports. However, the States did indicate that some errors were detected in the editing process and then corrected. Location reference problems appeared to be more prevalent on local highways than on the State systems. Arizona and Florida both felt that better training of police officers could improve the situation.

Some local agencies feel that slippage in the editing and verification of local accident reports at the State level has undermined the integrity of the State data base. Local jurisdictions generally do not edit accident reports before they transmit them to the State, and some jurisdictions feel that the State needs to improve its editing, particularly with respect to accident locations. Errors in accident data are often detected when local jurisdictions review accident summaries and listings of high-accident locations provided by the State.

With the milepoint method of location referencing, distances are measured from the beginning of a route. When sections of the route are realigned, this distance changes for all points beyond the revision. To compensate, either all the milepoints beyond the realignment are adjusted or a correcting equation is introduced near the change. Because neither of these methods is easily understood and applied by many users of the data, and because of the need to make extensive corrections in computer files, States are gradually shifting from milepoint to link-node systems. With link-node systems, routes are broken down into short segments so that the problems caused by alignment changes are contained and more easily dealt with.

Pennsylvania uses route number and roadway features to record accident locations but is planning to change to a link-node system to expedite the linkage of accident data with highway inventory files. Illinois DOT officials expressed concern that the location systems used by their various units (e.g., traffic, bridges, construction) could not "talk to one another." An Illinois committee selected a link-node system as most appropriate but recommended that the marked route system be retained because of its wide usage.

A number of State highway agencies are responsible for coding and entering data, and translating and adjusting the information on the police report. Reports of accidents on Washington highways are sent to the DOT for location coding before any data are entered into the accident information system by the Washington State Patrol; some local agencies code locations for non-State roads. California Department of Transportation enters location data to complete the coding process initiated by the California Highway Patrol. In New York, the Department of Motor Vehicles enters all accident data and then furnishes a computer tape to the highway department which revises it to meet its needs. The procedure in Missouri is similar to that in New York. For a number of years, Michigan has used a location reference system, developed cooperatively by the highway department and State Police, which involves a minimum of manual accident location coding. Instead of sending paper reports to the State highway agency for data entry, some local jurisdictions prefer to edit and enter the data themselves to ensure that it meets local needs and is readily available.

As noted earlier, much of the problem in recording accurate location references is due to human error. In the long term, this problem may be eliminated through the application of innovative technology which could provide accurate and automated positioning capabilities. One approach, which is really an improvement of the coordinate method, is the Global Positioning System (GPS), which determines positions from space by means of satellites. GPS consists of three components: satellites, a control system, and users. When fully deployed in the early 1990's, the satellite segment will consist of 18 operational satellites and 3 in-orbit spares. (37)

One of the most significant and unique features of space-based positioning systems, such as GPS, is the fact that the signals are available to users at any position on earth at any time. In a 1986 report, "Guide to GPS Positioning", D. Walls noted that "with the advent of the Global Positioning System, we are entering an era of accurate positioning, available on demand, 24 hours per day, 365 days per year, from any location in the world." (37) Of course, users must purchase appropriate receiving equipment. The sophistication and cost of the equipment will depend upon the location accuracy desired.

It is expected that the GPS will have a significant impact on the future of other methods, especially the Loran-C (Long Range Navigational) method. Walls reported that most military use of Loran-C could be phased out by 1992, assuming that GPS becomes fully operational by 1988. (37) A decision on future civilian use of Loran-C will be made in 1987 based on consultation with national and international bodies concerned with navigation. In any event, the operation of the system for civilian use may be a reality before the year 2000. When GPS costs drop below the costs of competing systems, it will erode the user community for other systems.

In the future, accurate positions will be a cheap, readily available commodity. It can thus be reasonably expected that such a system, when fully operational, will generate a large community of users. As large markets for GPS receivers develop, competition and economies of scale will lead to very low cost receivers. In his study, Walls stressed that there are no technological barriers to low-cost receivers; it is strictly a question of how many units are necessary to recover the developmental costs and make a profit. He reported that several GPS manufacturers claimed large-scale production costs of $1000 per unit or less. Walls predicted that the near-term trend in satellite positioning will be toward smaller, cheaper, and more easily operated receivers. A hand-held GPS receiver, not much larger than a standard deck of playing cards, is under development for the Department of Defense. He anticipates that eventually there will be "wrist locators," cheap accurate devices that would be as common as today's electronic wrist watches. (37)

The high precision of GPS measurements also makes it an adequate tool for a variety of tasks in surveying and mapping. In fact, it is likely that the system would be applicable to referencing both accident location and roadway inventory data. In short, the quality of accident data should improve as the GPS or similarly reliable systems become available to States and their local jurisdictions.

Human errors in estimating and recording accident locations need to be minimized. Technology which eliminates the need for reporters to estimate, measure, and manually record distances at accident locations must be explored. The technical and economic feasibility of using the Global Positioning System and other innovations as a means of referencing accident and roadway inventory locations should be investigated and pilot-tested at the earliest opportunity.

Highway Traffic and Inventory Data

Traffic Data

State highway agencies maintain continuing programs for collecting traffic volume data for planning and safety purposes. Special units within State highway agencies are usually assigned the function of traffic data collection. A number of problem areas relative to traffic counts were mentioned by State officials during this study. Some of these officials were users, rather than collectors, of traffic volume data. In Illinois, budget cuts in recent years have affected data availability; for example, volume data for interchange ramps are not currently available. In one State, highway officials noted that much of their volume data is manually compiled for specific applications and are not entered into the computer system where they could be used in conjunction with accident data. As a result, the quality of volume data used in computing accident rates was low.

Generally, States maintain adequate traffic engineering staffs to enable their inventory units to function effectively. Arizona, California, Delaware, and Florida have experienced improvement in the quality and quantity of traffic volume data over time. These States cited increases in the number of automatic traffic recorder stations, together with automated classification and instrument communication via telemetry, as reasons for the positive trend. Typically, State traffic counting programs include coverage counts, permanent counts, vehicle classification and selective inventories depending on the need. All States have well-established procedures for sampling and adjusting collected data.

The continuing advancement in data collection technology has made it possible for States and some progressive local jurisdictions to improve the timeliness of field data. There is a definite trend toward increased quality and quantity of traffic volume data among the States and more progressive urban jurisdictions.

Among the counties and cities, there are wide variations in traffic inventory programs. Major cities and counties where there is an adequate number of traffic engineering employees tend to be as advanced as the States in traffic engineering inventories. Rural jurisdictions tend to employ skeletal traffic engineering staffs and are often unable to maintain effective traffic inventory programs. Surprisingly, the interview team found that two urbanized counties, from those visited, are suffering from traffic inventory deficiencies because of inadequate staffing. Neither county has permanent count stations. In both counties, attempts to cover all roadways are done on a biannual basis. Officials in one of these two counties have a continuing volume inventory program based on portable counters and annual inventory of all roadways with average daily traffic volumes greater than 2500 vehicles per day. Officials there claim that their program is very successful and has always provided timely data for safety work. In New York, however, Westchester County has a well-staffed unit whose function is traffic inventory. This county has one permanent count station, relies on data from the State's permanent count stations and conducts volume counts on all roadways on a two to three-year frequency. The county has modern portable counting equipment, some of which has vehicle classification capability.

Arizona, California, New York, and Pennsylvania mentioned the lack of data for roadways administered by local jurisdictions as a continuing problem. Insufficient and inaccurate data and failure to update records on a regular basis are deficiencies in the local jurisdictions. For example, officials in one State noted that traffic volume data are low in quality since they are collected by administrative districts where volume counting is a low priority.

The study team believes that the deficiency in volume counting will improve; the traffic engineering community is well aware of inadequacies. Rapid economic development tends to force local jurisdictions to employ the traffic engineering staff needed for effective counting programs. Staffing improvements are occurring sooner in urban counties and satellite suburban incorporated cities than in rural jurisdictions. The increasing utilization of telemeterized Automatic Traffic Recorders (ATR) will continue to facilitate broader coverage and better traffic counts than in the past. In addition to traffic counts, the ATR's provide speed and vehicle classification data.

Roadway Inventory Data

Roadway inventory data includes information on the physical and environmental characteristics of highway segments. The inventory information is used to identify factors contributing to accidents; for example, sideswipe accidents may be related to inadequate lane width. Inventory information is also used to ensure that proposed countermeasures are feasible for improvements at specific sites.

The study team found that one or more of the following methods were used as sources of data for roadway inventory files: (1) as-built construction drawings and work orders, (2) windshield surveys, (3) other field surveys, and (4) photologs. The first two methods were by far the most common.

Highway inventory information on local roads is generally lacking. Further complicating the situation is the fact that the inventory data of many agencies are collected by several different divisions (e.g., bridges, construction, planning, and traffic). Under these circumstances, conversion to an integrated system is a slow process and will involve reaching an agreement on such mundane matters as a standard system for stationing routes.

Since 1970, most State highway agencies have initiated photolog programs. In some States, photologging has been used to inventory hazardous roadway elements. Although photologging has traditionally involved the use of 35 mm film, the Connecticut Department of Transportation has made use of laser videodiscs, computer graphics, and a personal computer to maintain its photolog library. (38) The photolog film for the 4,000-mile highway system and 600-mile rail system corresponded to more than 920,000 frames or 660 reels of photolog film but was transferred to only 15 laser videodiscs.

According to Zegeer, the advantage of laser videodiscs include the following: (1) denser information storage, (2) fast random access, and (3) greater physical durability. (38) A laser videodisc player connected to a microcomputer is capable of searching any of the 54,000 frames on one side of the disc in less than 3 seconds. Using the laser discs, film images can be enhanced, and zoom-in versions of the road provide greater detail. Also graphic overlays including information about location, road roughness, and engineering functions can be utilized. The major disadvantage is that the first or master disc is expensive.

Automated and semi-automated methods have been developed to facilitate the collection and recording of roadway elements. Using these techniques, information can be automatically collected and stored by microprocessing equipment. Zegeer categorized these methods as the following: (1) microcomputer recording systems, such as those used for obtaining inventories of signs or cross sectional characteristics; (2) pavement inventory systems such as those used to measure skid resistance and rideability of the pavement surface; and (3) change sensing systems, such as those used to measure horizontal and vertical alignment. (38) Automated and semi-automated methods are frequently used to supplement manual or photolog methods.

Of the States participating in this study, Arizona appeared to be making the greatest progress in terms of new technology for acquiring roadway geometric information and is in the process of examining the feasibility of microcomputer usage in collecting and storing roadway inventory data. A portable microcomputer terminal operated by the driver of a vehicle has been tested for recording roadway data; interim results are promising. Other plans include the addition of horizontal and vertical alignment information to the existing database. A new device, the Fluke Profile Reader, that has the capability of reading vertical alignment data on the scene is being tested. Equipment to perform similar functions is also under development in other States.

Future Trends

Although the existing situation with respect to traffic and roadway data is not as good as might be desired, the future trend appears positive. Budget reductions in many agencies have resulted in reduced expenditures for equipment and personnel in these areas. However, at the same time, technological advances are increasing the sophistication while reducing the costs of data collection equipment. The increasing use of automatic traffic recorder stations has resulted in an increase in the amount and quality of traffic volume data collected by State agencies. Additional technological improvements are expected in this area.

A similar situation exists with respect to roadway inventory data. In most States, even basic data such as horizontal and vertical curvature are not available in a form that can be integrated with accident record systems. However, the outlook for the future is positive. Virtually all States are studying or at least thinking about integrated traffic, accident, and roadway databases. Agencies that have proceeded in this direction have found direct benefits to both the inventory and the safety systems. An important plus is the possible integration of safety information with other systems such as financial management, project development, and maintenance management. This will allow managers to analyze safety data as part of their decision making and will permit greater evaluation efforts relative to safety.

Another positive trend is that the technology for data collection and management is constantly evolving. It is anticipated that in the near future, low-cost automated devices will be available to measure and record highway geometry and environmental information. The most appropriate system might be one which combines field techniques (e.g., automated collection of horizontal and vertical curve data) with remote data collection through photography or other types of sensors. It should not be difficult to adapt remote sensing and pattern recognition technologies, more commonly used in land use planning and natural resource applications, to collecting highway inventory information. Computer graphics, laser videodiscs, and related technologies offer new approaches to retrieving and presenting highway information in a timely and meaningful fashion.

A serious continuing deficiency in volume and roadway inventory data for roads administered by local jurisdictions, however, has made and will continue to make it difficult to link that data with accident data. Principal deficiencies are insufficient and inaccurate data, and a failure to update the data on a regular basis. While part of the problem can be attributed to funding constraints, many local officials do not appreciate the need for the data. An obvious solution is additional funding for personnel and equipment necessary to collect data. However, unless there is an appreciation and understanding of the need for the data it is unlikely that the funds would be used effectively.

In addition to financial resources, there is a need for education. In the absence of any formal education programs, tort liability problems may serve as a stimulus for improved data collection in many local jurisdictions. The availability of low-cost, user-friendly roadway inventory microcomputer software, accompanied by appropriate training, would be a stimulus to improved data collection. The increasing use of microcomputers at the local level should help in this regard. Specifically, arrangements where local jurisdictions have access to State accident data are an incentive to improved overall data collection. Another incentive would be local traffic advisory committees. State agencies should encourage local communities to form such groups. As the committees begin to investigate problems, they would soon find out which data elements are needed to make informed decisions. When data are lacking, such groups can be effective lobbyists for the requisite equipment and data collection efforts.

Data Processing and System Integration

Since passage of Federal highway safety laws in 1966, States have been encouraged by FHWA and NHTSA to develop safety recordkeeping systems capable of correlating data from accident, driver, vehicle, highway inventory, and other safety-related computerized data files. A parallel effort has been made by FHWA highway planners to encourage development of integrated highway information systems. At the State level, funds for both of these efforts went into a single system. Progress has been slower than expected, largely because of the massive amount of manual work required in the collection and processing of the data. Recent developments in automated data collection and processing equipment and the increased understanding of what computers do -- by-products of the spread of microcomputers -- have accelerated the development of integrated data systems that provide for the linkage of data from various sources. Development of integrated data systems is increasing the accessibility and usage of data for traffic safety applications.

Efforts to integrate safety recordkeeping systems and highway planning systems have been continuing since the 1960's. While NHTSA has promoted Statewide Integrated Traffic Records Systems (SWITRS) to support safety programs, FHWA promoted

Integrated Highway Information Systems (IHIS) to support highway planning and other highway programs. In practice, whether the core of and integrated State data system was called a SWITRS or an IHIS often only reflected the interests of the person who controlled the system. State accident and highway inventory data files are primary elements of an integrated State data system, whether SWITRS or IHIS.

In 1984, Congress initiated a program of additional safety grants to the States, under the provisions of Public Law 98-363, for the establishment or improvement of Comprehensive Computerized Safety Recordkeeping Systems (CCSRS). In practice, a CCSRS is only a renamed SWITRS, but the Congressional action served to reemphasize the need for effective integrated data systems in the States. A CCSRS is a State-administered system comprised of computerized files of data on motor vehicle traffic accidents, drivers, vehicles, and highways. (4) The files, which are customarily administered by different agencies, are linked within a system which permits correlation of data from separate files. State and local agencies can take advantage of the CCSRS to identify high-accident locations and hazardous roadway elements, to develop accident surrogates, to evaluate highway safety projects and programs, to monitor designated truck routes, and to provide selective traffic law enforcement. A CCSRS offers the opportunity for substantial benefits in a number of areas. One identified benefit is a reduction in data entry cost. Such systems provide powerful tools to identify, analyze, and solve highway safety problems.

Recent developments in computer hardware and software have accelerated the improvement of integrated systems. Storage of data is becoming more economical, and access to the data is becoming easier, especially for users who are not trained as computer specialists. However, it is essential for State and local agencies to coordinate their data collection and processing efforts closely to get the maximum benefit from a CCSRS.

For the safety programs administered by the FHWA, it is likely that the use of data from integrated State systems will increase substantially in the future. While primary applications for the data in these systems are within the States, both the States and FHWA will use the data for multi-State studies. In <u>Assessment of Existing Data Bases for Highway Safety Analysis</u>, a recent study performed for FHWA, it was recommended that FHWA develop a data base for its safety analyses by merging data from the integrated accident and roadway data files in several States. (14) A study to design a prototype of this National Safety Information System, incorporating data from four or five States, began in August 1987. Data from additional States may be added later. Such a system would not have been feasible a few years ago, but with the increasing integration of State data and the reduced scope of NHTSA data collection programs, both its cost and the potential for duplicating NHTSA efforts have decreased.

There has always been some natural friction between State and local organizations involved in the collection and processing of accident data. Local agencies tended to resent the reporting burden placed upon them by the State and complained, often with considerable justification, that they got very little in return from the State or that what they got was neither timely nor accurate. The State, on the other hand, sometimes complained that reports submitted by local agencies for the accident data base contained many errors and were often late. These complaints were also often justified. With current limitations on personnel at all levels of government, increasing capability to use accident and other data from integrated systems, and vast improvement in data processing and transmission technology, both local and State agencies can gain substantially from closer coordination. State control of accident data standards is necessary to ensure that data from all localities in each State are compatible and can be used to support State programs. The States must continue operation of their accident data bases as part of their CCSRS and IHIS systems. Local agencies should be able to access the State data freely and to modify subsets of that data as desired to support their own programs. Agreements for the entry of accident data into the State system should be worked out cooperatively between State and local agencies to ensure that the data meets the needs of both. Direct entry of data by local agencies into the State system, edited to State specifications and subsidized by the State, may be the most satisfactory procedure in many places.

In an effort to gauge the quality of reporting in local jurisdictions, the study team conducted discussions with officials of local governments. White Plains and New York City, New York; Sacramento and Los Angeles, California; and Prince George's and Montgomery Counties in Maryland were among the local jurisdictions contacted. The study team found that local highway officials are just as concerned as State officials about the quality, quantity, and availability of accident data. While many local officials would prefer to collect and process their own data without State interference, budget limitations which often keep them from collecting much of the accident, traffic and highway inventory data are also likely to keep them from developing ideal local systems without State help.

Direct entry of local accident data into State data systems is under consideration by a number of States. Using microcomputers, many local jurisdictions in Ohio have developed accident data systems that duplicate the State's system. Some of these local jurisdictions are able to key in police accident data before sending the reports to the State, resulting in significant labor savings. Local computerization efforts were assisted by the State through the use of Section 402 funds. This decentralization effort improved the timeliness and accuracy of the accident data files. The protection of sensitive information in the accident files was accomplished by blocking access to selected data fields. (21)

Similarly, rather than stopping the processing of PDOs to accommodate a backlog in accident processing, the Michigan DOT together with the Michigan Department of State Police (MSP) utilized the Michigan Traffic Records 402 Funds to support the accident records system. As a result, a prototype microcomputer-based input system was developed and implemented at the MSP Traffic Service Division to replace an older, inefficient system. (25) Currently, the system is being evaluated and refined. The system is flexible and could be transported to the field so that local police departments could enter accident report information and have it immediately available for their jurisdiction. (25)

Technological advancement during the past decade has not focused on accident reporting. Recent advances in data collection and processing have generally been applied to high-volume commercial operations or high-volume government operations such as driver licensing, vehicle registration and other revenue-producing programs. For most police agencies, accident data collection is a low-volume operation that does not warrant large expenditures for automation. With the rapid decline in the cost of electronic data collection and processing equipment, however, automation of accident data handling at the local level is now becoming feasible.

Advances in computer technology are expected to lead to major improvements in the accuracy and timeliness of accident reporting. Use of field computers to record data, electronic determination of accident locations, and telemetric transmission of reports to State files are under experimentation. Wide application is not likely in the short term, and there is no indication whether the time saved in preparing accident reports will encourage the police to report more PDO accidents. What is certain is that computer technology will definitely improve the quality and availability of accident data for planning, implementing, and evaluating highway safety projects and programs. This improvement has already begun and will continue in parallel with improved computer technology. The existing avenues of information exchange -- workshops, journals, society meetings, business advertisements; State, county and city associations, and technology transfer centers -- will ensure the dissemination of new and emerging technology.

Florida is testing the feasibility of using portable microcomputers for field applications as a means of speeding up and improving the quality of data sent to its Department of Highway Safety and Motor Vehicles (DHSMV). A microcomputer grid system (with graphics capability) is being studied to assess its applicability to the Florida accident data base. Once the system becomes operational, officers would use a portable microcomputer to report accidents. Upon return to their stations, the officers would produce a hard copy and then transmit the information electronically to DHSMV. DHSMV would edit the data on the same day and transmit it to FLDOT. In theory, the FLDOT Traffic and Safety Division could review the accident information in two to three days.

In some jurisdictions (e.g., Chicago and Pennsylvania) drivers are required to appear in person at a police station to report accidents when police did not get to the scene. Automated telephone equipment might be a cost-effective way of collecting this data. With computerized voice communication, it is possible to store and print out accident reports from recorded responses to questions asked by a microcomputer. Copies of the reports could be mailed to reporting drivers for verification.

Some of the most time consuming items on State accident reports are driver and vehicle identifications which are copied manually from computer-printed documents. Police at the scene of an accident are already able to retrieve data from State driver license and vehicle registration files to confirm the validity of these documents. It should be possible very soon to transfer these data automatically from the computerized files to the accident data base and, if necessary, to printers in police cars. This would not only eliminate the manual copying of data already on file, it would greatly reduce the time needed for data entry and editing. Highway inventory data, at least for roads on the State systems, could be retrieved in much the same way.

For many years, accident data file managers have envisioned the day when the data on accident reports could be read electronically and entered into the data file without manual keying. The hardware and software are currently available, and there is an optimistic outlook for increased automation.

Due to budgetary constraints over the past decade, there has been a substantial decrease in the number of people employed in the editing of police accident data. The impact of decreased personnel has been mitigated by the increased use of computer checking, but in the face of increasing numbers of reports, this has not been enough to prevent a number of States from losing ground in their attempts to make the data available in a timely manner. In the early 1970's, it took New York about one month to get an accident report into its computer file; because of an increased workload and smaller staff, it now takes four months. New York processed 400,000 accidents in 1975 with 125 people. In 1985, a staff of 75 processed 800,000 accidents. Despite a more than threefold productivity increase, the staff is getting further behind. A number of States report 30 to 50 percent cutbacks in accident data processing staff during the past decade.

Arizona, Florida, Illinois, New York, and Pennsylvania all expressed concern about the timeliness of accident data processing. Highway agency budget cuts had a major impact, affecting both the time it takes to process data and the quality of the data processing. These resource constraints have meant smaller staffs and the inability to acquire automated equipment. The smaller staffs, in turn, have resulted in longer processing times and poorer quality control.

At the local level, there is tremendous variability in the quality of data processing, ranging from a complete lack of processing to sophisticated computerized systems that are comparable to those found at the State level. The project interviews revealed that a number of States are reviewing their data processing needs with an eye toward implementing an automated accident data processing system. For example, Delaware is discussing with local police agencies a proposal for an automated reader system using a digitized accident report form. If such a system is adopted, it will reduce field and office labor requirements significantly, freeing personnel for higher priority tasks and reducing errors.

Microcomputers have substantially increased the use of data in traffic records systems. A microcomputer-based accident information system developed in Vancouver, Washington, for its own use has been very successful. State officials are now considering making the system available to other local jurisdictions. In a number of States it is possible for the staff in State or local agencies to transfer data from mainframe files to personal computers. Michigan's effort to provide instantaneous and convenient access to local sign and bridge inventories, as well as accident records, was demonstrated through a project where raw data files were moved from mainframe to microcomputer storage. This downloaded data was then managed with R:Base 4000, a commercially available data base management system. (15) Michigan is also conducting a pilot project for a microcomputer-based sign inventory system involving nine Districts of the Department of Transportation. Upon completion, this system will have the capability to generate drawings showing the location of signs at roadway intersections and segments. (15)

The increasing use of microcomputers in accident analysis is a positive trend. As State and local accident data processing systems are integrated with microcomputers, a number of positive outcomes should develop. Microcomputer usage should increase in the future as young, computer-literate engineers accelerate the trend toward increased use of accident data. As usage of the data increases, the quality of the data should improve.

Surrogate Data

Historically, highway professionals have relied heavily on police traffic accident reports to identify hazardous locations, to select and evaluate accident countermeasures, and to prioritize highway safety improvement projects. While the value of the accident data base cannot be underestimated, highway agencies have long recognized major shortcomings in the highway safety improvement process, especially when highway accident data are the primary information source for highway safety planning, implementation and evaluation. Incompleteness, bias, inaccuracy, unavailability, and untimely reporting and processing of accident, traffic and roadway data are among the problems that have encouraged researchers to search for alternatives to police data. These alternatives have included measures and studies generally classified as "surrogates."

Since accidents are rare events, the use of surrogate measures in lieu of, or as supplements to traffic accident reports might be more practical in some situations than the use of actual accidents, especially for interim analyses before accident data are available.

Surrogate measures identified in the literature include items such as lane and shoulder width, roadway alignment, skid characteristics of roadways, traffic volume, delay, traffic control operations, traffic conflicts, and vehicle lateral placement. (See references 8,22,23,28,29,30.) While surrogate measures have been studied, their relationship to accident experience has been mixed. In a recent study by Datta, stepwise regression analysis was used to test for statistically significant relationships between one or a combination of several operational and nonoperational surrogate variables and accident experience at isolated curves, rural signalized intersections, and urban divided tangents. (5) Three years (1976-1978) of accident data were used in the analysis. The findings failed to identify a good surrogate measure for total accident rate when all accidents were analyzed. (5) However, in their study, Terhune and Parker found that average annual daily traffic (AADT) and degree of curvature were the best accident predictor variables for rural isolated curves. (29) Using multiple regression analysis, Terhune and Parker were able to estimate accidents per million vehicles with 21 to 31 percent of the variance in accident rate explained. (29) Similarly, Glauz and Migletz estimated average accident rates nearly as accurate, and just as precise, as those produced from historical accident data, using traffic conflicts of various types. (8,9) The traffic conflict technique (TCT) is useful and has received national support. (See references 3,9,26,32.) Swedish highway safety officials have also used TCT to supplement accident data. (32) The near-accident reporting technique, similar to the traffic conflict technique, has been used in Europe as a quick and practical procedure to quantify occurrences which are difficult to study in other ways (e.g., pedestrian conflicts). (32)

Although the potential value of nonaccident measures of effectiveness for evaluating the interim effectiveness of safety improvements has increased steadily, the actual use of accident surrogates has not been well received. Of the nine States visited, none is seriously considering any significant use of surrogates in lieu of or as a supplement to accident data. A traffic conflicts technique identical to the one identified in the literature has been used in a number of States for special situations, but the technique is considered to be too labor-intensive for routine application. (See references 8,16,24,32.)

Limited personnel resources were often cited by States as the reason that surrogates are not likely to replace accident data.

Tort claims have also made some States such as Pennsylvania and California reluctant to rely on surrogates. In the absence of evidence that would easily convince a judge and jury that a surrogate measure was directly related to accidents, engineers are not willing to put themselves in a position where they may have to defend the use of surrogates in court.

In spite of their reluctance to use surrogates, State and local highway officials support the premise that there is a persistent need for accident surrogate measures, especially when reduced reporting and insufficient accident data exist. Theoretically, such measures of effectiveness must possess a definite relationship to accidents, yet be sensitive to safety-related changes in the highway system. Furthermore, from an administrative viewpoint, surrogate measures must be relatively easy to collect with minimal training and equipment and yet provide accurate information. The outlook for accident surrogate measures depends on continuing research. Meanwhile, the majority of highway agencies prefer to improve the quantity and quality of accident data rather than resort to the use of surrogate measures.

Laboratory and driving simulator tests of individual driver performance have been used to assess accident potential. They have provided well-controlled settings for measuring the relative effectiveness of new signs, signals, markings, and other highway and traffic control characteristics. Human factors measures such as driver expectancy, comprehension and compliance, reaction and preference, and vehicle lateral placement are potentially useful measures of effectiveness to predict driver understanding and behavior relating to traffic control devices. (7)

Recently, the usefulness of other potential sources of accident data such as insurance and motor vehicle records has been researched. (1,20) The findings were not very encouraging. For example, the National Transportation Safety Board found that, with the exception of automated claims data from insurance companies, insurance claim files are of little value. (20) There are several reasons to use caution with such data. Insurance company claims adjusters are not trained accident investigators. In fact, they seldom see the vehicles that were involved in a claim and almost never visit the accident site. An insurance company collects the minimum amount of information necessary to establish whether it must pay a claim. Following the claim settlement, most insurance companies computerize very little of the information obtained during the claims adjustment process. Common practice in the business is to computerize only that information needed for accounting purposes. It is generally felt that other, unautomated data are too undependable, too time-consuming and costly to retrieve, and too disruptive of routine insurance business.

Other reasons that insurance data should be viewed with caution include:

o Bias -- Data from any single insurance company may be biased because the segment of the population insured by any one company is not representative of the population at large.

o Uninsured Motorists -- A significant segment (at least 10 percent) of the driving population does not purchase insurance.

o Unreported Accidents -- Many crashes, especially those that involve minor damage, are not reported to insurance companies.

o Timeliness -- Even if data from claims files were reliable, those files are not available until claims are closed. Processing of the simplest of claims may require several months with the time required to settle a claim increasing as the complexity of the claim increases.

Insurance companies pay relatively little attention to highways. However, the Insurance Institute for Highway Safety and Nationwide Insurance Company have been active advocates of improved roadside design. It was suggested by the National Transportation Safety Board that FHWA might broaden its research efforts with a project that would use the claim processing mechanism of insurance companies to survey the prevalence and cost of collisions with roadside structures. (20) The most successful attempts to use insurance data have been special projects that have avoided claim files and have involved or sought advice from insurance industry researchers.

Problems were also found with hospital records of traffic accidents. Hospital records are confidential and highly guarded sources. Needless to say, hospital records, if available, include only records of injury and fatal accidents and not PDO accidents.

The only supplement to police accident reports that has any substantial support at this time is driver accident reporting. Other potential sources of accident data elements, such as insurance and hospital records, motor vehicle records, and the like cannot fill the gaps in police and driver reports. None of the States visited expressed any willingness to use such potentially complementary data sources.

In their emphasis on the need for police or driver reports of PDOs, State engineers may be saying that PDOs are the best available surrogates for more severe accidents. Where traffic is light, it is difficult to identify hazardous locations because of the statistical uncertainties associated with small numbers. The inclusion of PDOs is very useful in reducing these uncertainties. In addition to using accident data to identify hazardous locations, engineers often use the reports of accidents at hazardous locations to diagnose the hazard. Here again, it is helpful to have the PDO reports in addition to the reports of injury accidents to determine what has been happening.

Learning From Tort Claims

One of the most disturbing trends to affect highway departments in recent years has been the increasing number of tort claims resulting from alleged highway defects. The impact of this phenomenon on the highway departments of State and local jurisdictions depends to a large extent on the legal environment in the various jurisdictions. In the few remaining States which enjoy sovereign immunity, tort liability is not a major concern. However, it is probably only a matter of time until sovereign immunity is abolished in every State. In a number of States that have already lost sovereign immunity, tort liability considerations are driving the accident information systems as agencies try to develop and refine approaches that will reduce their liability exposure.

As the tort liability problem continues to grow, there is an increasing likelihood that legislative action will be used to halt or reverse the trend, much like the no-fault insurance provisions that were introduced in response to the automobile liability crisis of the 1970's. Twerski describes the tort reform legislative activity taking place today as unparalleled, and he postulates that tort litigation will look very different two or three years from now. (34)

Warren B. Dunham, Director of the Iowa Department of Transportation, reported that within a five year period, 1200 claims totaling $293 million were filed against the Iowa DOT and $11 million in judgments were paid out. (6) The Department is actively working to change the State's tort law. In addition, they constantly analyze case content to determine areas where they are most often at risk. Once these areas are identified, Iowa can target resources to solve safety problems and reduce future tort exposure. However, from a practical standpoint, the agency will never have sufficient funds to bring the entire system up to state-of-the-art standards with each improvement in material, design, or signing. As a result, the Department has structured itself for defense. There was a conscious decision to concentrate resources on making it more difficult to effectively sue the department. These efforts are directed at developing and refining defensive mechanisms that will stand up in court. For example, it is now routine to perform an immediate investigation of fatal or serious personal injury accidents just in case some action might be filed within the next two years.

California lost sovereign immunity in 1967; it too has experienced an increasing number of tort claims. Twenty years ago the agency had one attorney to handle claims; now there are 100 attorneys performing this task. California is frequently charged with not acting soon enough to correct safety problems. As a result, several monitoring systems (median barrier, wrong-way, and wet pavement systems) have been implemented to monitor and detect safety problems. Those systems permit the development of countermeasures more promptly than would be the case if California engineers waited for annual accident data summaries.

Pennsylvania lost sovereign immunity in 1979; since then, tort claims have been increasing by 30 percent per year. In Pennsylvania, the threat of cross-examination in the courts has led engineers to rely more on accident data than on surrogate measures of effectiveness in countermeasure design. They have found that anticipated losses in tort cases can significantly affect the benefit-cost ratios of some improvements.

Maryland, which has also lost its sovereign immunity, believes that tort litigation will become more prevalent. Officials fear that the liability of the highway agency and its employees will increase due to the underreporting of accidents. Insufficient accident data diminishes the agency's ability to show clearly that its actions were appropriate and responsive to overall needs and that the safety program is organized so that priority projects will be implemented first.

The frequent occurrence of claims and the high damage awards resulting from tort litigation against highway agencies are having a major influence on the highway safety planning process. In some States, outstanding claims against public agencies far exceed the annual appropriations for all highway projects. Well established and systematic approaches for safety planning which attempt to identify a universal set of high accident locations without considering the tort potential and pattern are being modified to include strategies to minimize the potential for tort litigation and the associated financial damages. The trend in tort liability indicates that highway agencies as well as their officials have been the target of numerous lawsuits. Thus, it is not sufficient for safety officials to protect themselves from negligence suits by merely following traditional practices. Defensive highway safety planning is gradually emerging as the only strategy to curb the financial loss associated with tort liability.

As highway agencies attempt to be pragmatic in curbing tort damages, increasing emphasis is being given to countermeasure development for accident locations based on the severity of injury, with sites involving serious injuries and fatalities receiving priority attention. For most jurisdictions, programmed highway safety funds could never be enough to deal with all tort-influenced safety projects. Consequently, there is uncertainty about the amount of effort that should be directed at collecting, processing, and using noninjury accident data. It is particularly because of this transitional situation that some jurisdictions are not aware of the real state of noninjury accident collection. What appears to be certain is that neglecting the use of noninjury accident information resource may become the future basis for many lawsuits as jurisdictions overreact to the tort liability potential and neglect high-frequency noninjury accident locations which often become the fatal accident sites of the future. Hence, in the short term (the next five years), State highway agencies will experience a period of continuing adjustments as they respond to new twists in the tort problem. This will eventually result in an increased awareness of the need for jurisdictions, particularly the States, to have accurate, timely, and most extensive highway safety data to defend their actions in court. Meanwhile, the aggregate tort experience of the States will result in effective strategies for minimizing the potential for charges of negligence in highway safety work without sacrificing a comprehensive view of highway safety programs. In spite of short term adversity, there is some long-term optimism that after the dust has settled, highway safety planning may well emerge with improved effectiveness.

On the basis of the above information, it seems logical to conclude that an increasing number of highway agencies will find tort liability considerations impacting their accident recordkeeping systems and safety planning process. However, a potential contravening trend is the growing number of States which have enacted or are discussing tort reform legislation. It is the opinion of Moretti that tort reform is at hand and that the only questions remaining are in which States, to what extent, and when it will become effective. (17) Until then, defensive highway safety planning and extensive information gathering are the best options.

III. SUMMARY

Outlook for The Coming Decade

Police Accident Reporting

Highway and traffic engineers depend heavily on police accident reporting to identify safety problems and evaluate countermeasures. As technological advances increase their ability to use these data, the importance of police-reported accident data will increase.

Adjustments to the PDO reporting threshold will continue. Most States will retain dollar thresholds but there is a possibility that an occasional State will switch to a tow-away standard similar to that in Pennsylvania. When dollar thresholds are adjusted for inflation, PDO reporting will generally remain at levels suitable for support of highway safety programs.

As budget and personnel constraints continue to be a problem at all levels of government, pressure to cut back PDO reporting efforts will be increased. Actions to counter the underreporting will be needed. While the outcome of the above constraints may be severe in some States, the net effect on the quantity and quality of accident data for national programs may be relatively small.

The priority of accident reporting in police agencies will probably increase somewhat as productive use of collected data becomes more evident. The high-level support needed for this function should increase as recognition of the benefits of coordinated data systems grows.

Supplementary Accident Reporting by Drivers

As pressure to improve the cost-effectiveness of accident data systems continues, it is likely that greater use will be made of driver accident reports. Driver reports appear to be the best available method to expand the PDO data base in environments where reduced police reporting and tow-away threshold are established.

Police Training

The decline in formal training courses and the use of newsletters to improve police accident reporting, which was caused largely by resource limitations, appear to have hit bottom in most States. This undesirable status will be maintained unless there is deliberate actions whenever the economic climate improves.

Reporting of Accident Locations

Substantial improvements in the reporting of accident locations are expected in the next few years. As the use of integrated data systems increases, the location reference link between accident data files and traffic volume, highway inventory and other data files becomes more important and errors become more visible. Improvements in the operation of existing location reference systems and increased use of link-node systems are anticipated. Electronic systems such as the global positioning system (GPS) may be developed to the point where they provide accurate data at low cost.

Highway Traffic and Inventory Data

The accuracy and timeliness of traffic and inventory data will continue to improve as State and local highway agencies take advantage of advancements in data collection and processing technology. The largest improvement in data collection is expected to be in local agencies serving urban and suburban areas where economic development rates are high. Improvement in data for local rural roads will be continue to be slow.

Data Processing and System Integration

Technology advances in the past decade have accelerated development of integrated highway information or safety recordkeeping systems (IHIS, CCSRS) by dramatically reducing the costs of data processing and analysis. Indications are that as costs continue to drop, the usefulness and cost-effectiveness of integrated systems will attract much more top management support, at all levels of government, than they have had in the past.

Recognition of the benefits of State-local coordination in the collection, processing and storage of accident data will help to overcome much of the traditional reluctance of State and local agencies to rely upon each other's data. Direct data entry by local agencies into State data systems will increase, as will local reliance upon the data in these systems. If States do not facilitate local access to central accident files, the development of independent local accident data systems will increase.

The most important technological advances in the handling of accident data will permit the entry of accident data by the investigating officer from the accident site, and the transfer of data from driver, vehicle and highway inventory files to accident files while the officer is entering accident information.

The increasing availability and use of microcomputers for the analysis of accident and related data will tend to force the responsible agencies to improve the quality of data in State and local files.

Surrogate Data

While the use of surrogate data for specialized applications may increase, these data are not expected to have a major impact on the operation of State or local highway safety improvement programs. Surrogate data will not replace a substantial amount of police-reported and driver-reported accident data in the foreseeable future.

Learning From Tort Claims

As States continue to lose their sovereign immunity and highway agencies are found to be responsible for deaths, injuries and property damage resulting from traffic accidents, the increase in tort claims against State and local highway agencies is likely to continue. However, legislative reaction to unreasonable claims and excessive awards can be expected to slow the rate of increase. The study team believes that the overall tort experience of the States will result in effective strategies for minimizing risk without sacrificing a comprehensive view of highway safety programs.

Action in the Coming Decade

Police Accident Reporting

Highway and traffic engineers should continue to oppose substantial reductions in the level of police reporting to preserve the major data base supporting their safety programs. Engineers should work closely with police agencies to ensure that their needs for these data are understood.

Adoption of tow-away thresholds for PDO reporting should be opposed vigorously as a serious threat to the accident data base. Adoption of higher dollar thresholds can be accommodated where the ratio of PDO to injury accident reports remains above two or three.

Highway agencies should monitor the quantity and quality of police reporting to detect the effects of underreporting resulting from budget and personnel constraints, so that corrective action can be initiated before severe degradation of the accident data base.

Where short forms are proposed for the collection of PDO data, highway and traffic engineers should participate in the design of the forms to ensure that critical data elements are not omitted.

Engineers should continue efforts to enlist high-level administrative support for the collection and use of police accident data in support of highway traffic safety programs.

Supplementary Accident Reporting by Drivers

The use of driver reports to supplement police accident data should be supported by highway and traffic engineers where this can be shown to be cost-effective and does not lower the overall usefulness of State accident data bases. However, special accident report forms for drivers must be developed.

Police Training

To raise the quality of police-reported data, highway agencies should support the initiation or improvement of formal accident-reporting courses for police. Highway agencies should participate in the development of these courses to make sure that their interests in the data are explained correctly and completely. Engineers should also participate in teaching these courses to establish personal contact and foster better mutual understanding, respects, and communications among the collectors, processors and users of the accident data.

The use of newsletters to call police attention to accident reporting problems, remind police officers that the reports are important, and to promote better communications should be supported by highway agencies.

Reporting of Accident Locations

Action to improve the reporting of accident locations should focus both on improved operation of existing systems and on new technology to reduce the opportunity for human error. Improved operation of existing systems can be achieved by training of the personnel who collect and process the data or by enhancement of the systems.

Highway agencies should support research to develop new technology for determining the geographic positions of and recording accident data. Electronic systems should be explored.

Highway Traffic and Inventory Data

The current highway agency support for development of technology to improve highway traffic and inventory data collection and processing should be continued. State highway agencies should encourage local communities to form traffic advisory committees which focus on the needs for traffic and inventory data and foster cooperative efforts on the local level to meet those needs.

Data Processing and System Integration

Highway agencies involved in the development and use of integrated highway information or safety recordkeeping systems (IHIS, CCSRS) should be aware of the need to demonstrate, on a continuing basis, the cost-effectiveness of these systems. This demonstration is needed to obtain and retain the high-level management support that is needed to support continuous and efficient operation of integrated systems.

State agencies which administer accident report data bases should develop procedures to coordinate State and local systems. These procedures would typically include local participation in data entry and editing -- particularly editing of accident location entries -- and the transfer of data to local systems.

Research programs to develop applications of new technology for accident data collection and processing tasks should be encouraged and supported.

Engineers and other users of accident data must have ready access to microcomputers if they are to make the most effective use of available data.

Surrogate Data

Research on the use of surrogate data, to be used in place of or in addition to accident data, should continue at a level commensurate with anticipated benefits from such use.

Learning From Tort Claims

The agencies which are the targets of tort claims for damages resulting from highway accidents should increase their use of information contained in these claims to improve their highway safety programs and the data systems which support them.

APPENDIX

LIST OF JURISDICTIONS CONTACTED OR VISITED

Delaware Department of Transportation, Dover

Pennsylvania Department of Transportation, Harrisburg

San Francisco, California

Wilmington, Delaware

New York City, New York

Los Angeles, California

White Plains, New York

Baltimore, Maryland

Prince George's County, Maryland

Montgomery County, Maryland

Sacramento, California

Arlington, Virginia

Huntington, West Virginia

Morgantown, West Virginia (Police Department)

West Virginia Department of Highways, Charleston

California Department of Transportation

Missouri Department of Transportation

Florida Department of Transportation

Arizona Department of Transportation

Illinois Department of Transportation

New York Department of Transportation

New York Department of Motor Vehicles

Maryland Department of Transportation

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16. Abstract
This report evaluates the quantity, quality, and availability of traffic accident and other safety-related data and their effects on the ability of Federal, State, and local governments to successfully perform highway safety missions. Practices in the collection, processing, and use of accident, traffic, and roadway inventory data in a sample of States and local jurisdictions are reviewed in terms of their impact on highway safety planning, implementation, and evaluation. The study notes the increasing use of microcomputers, the increased amount and quality of traffic volume and roadway inventory data, and the integration of traffic, roadway, and accident databases. Other findings include reduced reporting of property-damage-only accidents, increased numbers of tort liability claims, insufficient local data in State files, level of police training and interagency coordination, deficient local traffic and roadway inventories, and errors in the use of highway location reference systems. The study contains recommendations for accommodating and/or reversing some of these practices.

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METRIC (SI*) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
	LENGTH			
in	inches	2.54	millimetres	mm
ft	feet	0.3048	metres	m
yd	yards	0.914	metres	m
mi	miles	1.61	kilometres	km
	AREA			
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yd²	square yards	0.836	metres squared	m²
mi²	square miles	2.59	kilometres squared	km²
ac	acres	0.395	hectares	ha
	MASS (weight)			
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lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg
	VOLUME			
fl oz	fluid ounces	29.57	millilitres	mL
gal	gallons	3.785	litres	L
ft³	cubic feet	0.0328	metres cubed	m³
yd³	cubic yards	0.0765	metres cubed	m³

NOTE: Volumes greater than 1000 L shall be shown in m³.

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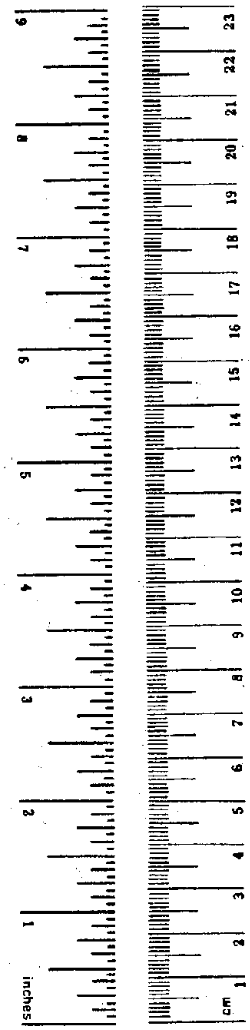
* SI is the symbol for the International System of Measurements



APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
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m	metres	3.28	feet	ft
m	metres	1.09	yards	yd
km	kilometres	0.621	miles	mi
	AREA			
mm²	millimetres squared	0.0016	square inches	in²
m²	metres squared	10.764	square feet	ft²
km²	kilometres squared	0.39	square miles	mi²
ha	hectores (10 000 m²)	2.53	acres	ac
	MASS (weight)			
g	grams	0.0353	ounces	oz
kg	kilograms	2.205	pounds	lb
Mg	megagrams (1 000 kg)	1.103	short tons	T
	VOLUME			
mL	millilitres	0.034	fluid ounces	fl oz
L	litres	0.264	gallons	gal
m³	metres cubed	35.315	cubic feet	ft³
m³	metres cubed	1.308	cubic yards	yd³

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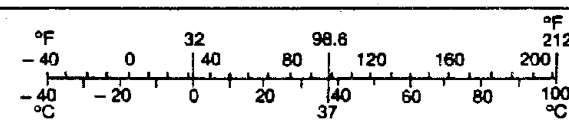

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