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The Efficacy of Roadside Inspections in Reducing Heavy Truck Accidents

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ABSTRACT

Motor carrier safety has recently received considerable attention for two reasons: the growing number and size of heavy trucks on our nation's highways, and the frequent severity of the accidents in which trucks are involved. One recent federal initiative is the Motor Carrier Safety Assistance Program. The cornerstone of this program is a system of random roadside inspections of large trucks (greater than 10,000 lbs. gross vehicle weight) and their drivers. These inspections are expected to result in a reduction in the number and severity of heavy truck accidents.

A comparison of the factors involved in truck accidents with the truck deficiencies most often uncovered by these inspections indicates that the inspection design does not address factors most often noted as causes of truck accidents. This study concludes that, to improve safety, more emphasis must be placed on driver-related violations—those most often cited as accident causes--as opposed to vehicle deficiencies which constitute the majority of defects revealed by roadside inspections.

INTRODUCTION

Motor carrier safety, always of concern, has recently received considerable attention because of the growing number and size of heavy trucks (more than 10,000 lbs. gross vehicle weight) on our nation's highways, and because of the frequent severity of heavy truck accidents. Although heavy trucks, when compared to other vehicle classes, are involved in relatively few traffic accidents, the number of fatalities is disproportionately large, particularly when smaller vehicles are involved. Consequently, truck safety has captured the attention of the motoring public and government officials.

THE MOTOR CARRIER SAFETY ASSISTANCE PROGRAM

Efforts to improve motor carrier safety have been high on the Federal government's agenda in recent years, perhaps the most notable example being implementation of Title IV of the Surface Transportation Assistance Act of 1982 which established the Motor Carrier Safety Assistance Program (MCSAP). The objectives of this program are:

. . . to reduce the number and severity of accidents and hazardous materials incidents by substantially increasing the level of enforcement activity and the likelihood that safety defects, driver deficiencies and unsafe carrier practices will be detected and corrected (49 CFR Ch. IIIB, 350).

Program objectives are achieved through roadside inspections, investi-gations, terminal safety audits, and follow-up enforcement.

The cornerstone of MCSAP is a system of random roadside inspections of trucks heavier than 10,000 pounds gross vehicle weight (GVW) and their drivers. These inspections are to be conducted by personnel from state and federal agencies. The inspections are defined for the purposes of MCSAP as:

. . . a procedure for examining certain key components of a vehicle and critical documents of the driver to detect those violations and defects most often identified as causing or contributing to commercial vehicle accidents [U.S. Department of Transportation 1984, p. 1].

While these inspections perform a valuable service by calling attention to the truck safety problem, and by identifying potentially unsafe vehicles and drivers and removing them from the highway, they may not effectively address those factors that contribute most often to commercial vehicle accidents.

FACTORS IN LARGE TRUCK ACCIDENTS

Most, if not all, vehicular accidents are complex events involving a series of related causal factors. As shown in figure 1, the interrelation of the many factors involved in traffic accidents makes it extremely difficult, and often impossible, to identify a simple primary cause. Any program designed to reduce accidents and improve highway safety must, therefore, consider them all. A recent U.S. Department of Transportation study on heavy truck safety describes the factors that should be addressed by such a program:

Motor carrier/heavy truck safety is affected by a complex and interrelated set of factors that include

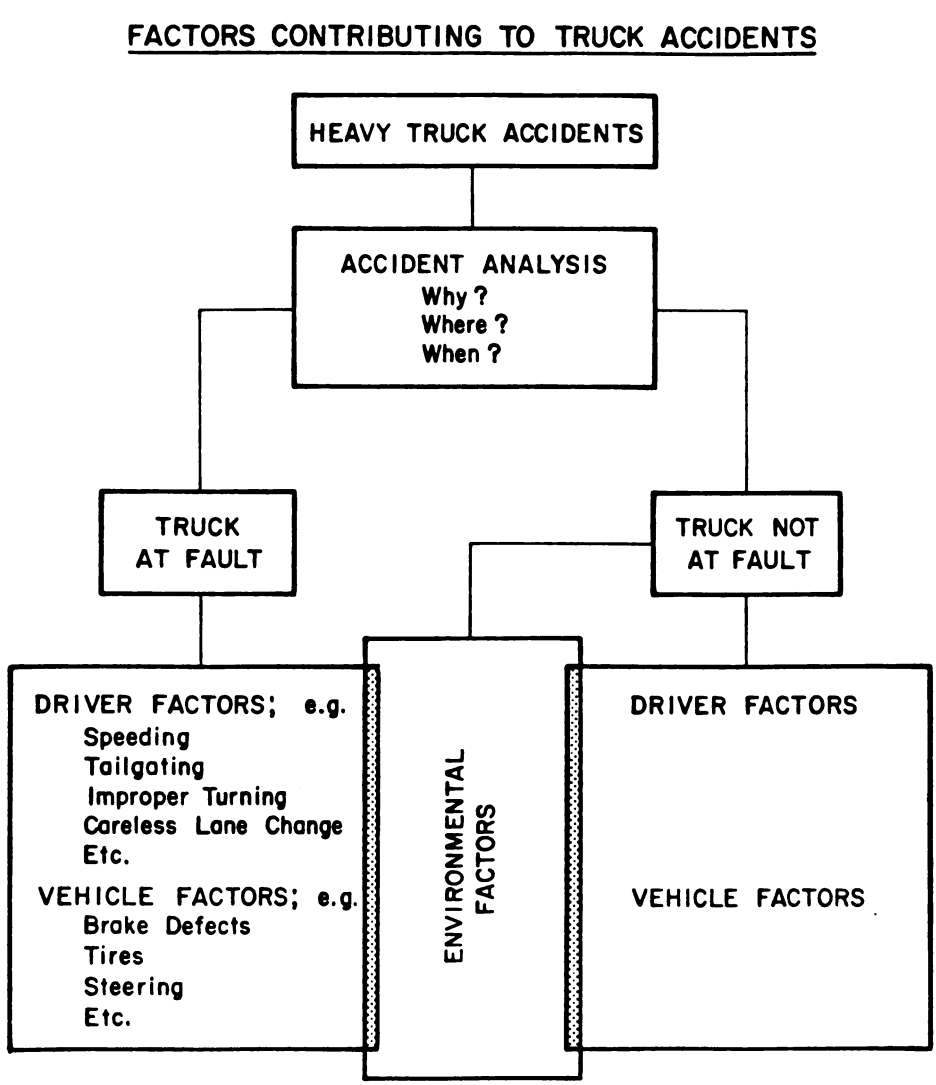

FIGURE 1. Factors contributing to heavy truck accidents.

driver, vehicle, highway/environment, motor carrier management practice and institutional issues. No one simple explanation exists as to why trucks crash. There are no "quick and easy" answers to the many complex safety issues raised by medium/heavy commercial vehicles. A balanced heavy truck safety improvement program, if it is to be effective, needs to be cognizant of these relationships and must incorporate elements that simultaneously address all these issues in some reasonable fashion [Clarke et al. 1987, p. 11].

Despite obvious difficulties, the most effective strategies to reduce truck accidents are clearly those addressing the primary causes of such accidents. There is strong evidence to suggest that roadside vehicle inspections by themselves are not sufficient to reduce materially the number and severity of large truck accidents.

OBJECTIVES OF THE STUDY

This study was designed to investigate the various causes of large truck accidents and to compare them with the findings of MCSAP and other similar roadside inspections. This analysis will provide conclusions concerning the effectiveness of road-

side inspections in identifying and reducing those factors cited as contributing most often to large truck accidents.

This presentation begins with a discussion of the study's methodology followed by a brief description of the MCSAP roadside inspection process. The next section will present findings of MCSAP inspections conducted in Pennsylvania. These results will be compared to the reported findings of Bureau of Motor Carrier Safety roadside inspections conducted before institution of MCSAP. The third portion of this paper will analyze the factors contributing to large truck accidents taken from data supplied by the Pennsylvania Department of Transportation and reported in the literature. The fourth section will compare the inspection findings with the accident data. The paper concludes with findings and recommendations concerning the efficacy of roadside inspections in reducing large truck accidents.

METHODOLOGY

To be effective in reducing the number and severity of accidents where culpability is assigned to a large truck, the MCSAP inspection program should actually identify significant causes of truck accidents and remove vehicles and drivers with these defects from the highway. To see if these inspections meet these goals, this study compared the findings of MCSAP and similar inspections to the truck-related factors noted as contributing most often to traffic accidents.

Accident data supplied by the Pennsylvania Department of Transportation was compared to that published by the Bureau of Motor Carrier Safety, the National Highway Traffic Safety Administration, and the Oregon Public Utilities Commission, as well as that contained in the current literature. From these sources a list of factors contributing to large truck accidents was compiled and then ranked according to the frequency that items were cited.

The findings of MCSAP inspections conducted in Pennsylvania from July 1986 to March 1987 were compared to the results of roadside inspections conducted by the Bureau of Motor Carrier Safety before institution of MCSAP inspections. The standards used in MCSAP were derived from the BMCS standards used before the program began. Inspections conducted by the Oregon PUC were also included. The standards used in these inspections were also derived from BMCS procedures. A list of noted inspection violations was compiled, and as in the accident analysis, ranked by frequency of mention.

The two sets of data, accident causes and inspection findings, were compared to note where the inspections address those factors that contribute most often to large truck accidents and where they do not.

MCSAP INSPECTIONS

Commercial vehicle inspections conducted under the provisions of the Motor Carrier Safety Assistance Program are designed to "remove potentially unsafe drivers and imminently hazardous vehicles from the Nation's highways [U.S. Department of Transportation, p. 2]." Vehicles for inspection are to be selected on a "first come, first inspected" basis from the vehicle stream passing the inspection site. Vehicle selection is to be random, although those in poor general condition or with obvious safety defects are to be given priority.

Once a vehicle is selected, it is subjected to a thorough inspection following the established guidelines. This inspection checks items considered critical to the safe operation of the vehicle: the brake system; tires and wheels; and steering, suspension, and lighting systems. Inspectors also review the driver's logbook, driver's license, and medical certificate. Any violations detected during the inspection are entered on the inspection form, a copy of which is given to the driver.

The MCSAP inspection process divides violations into two classes. The first class, "basic" violations, are not considered to pose an imminent danger to the public. Included in this class are record-keeping deficiencies on the part of the driver as well as minor vehicle defects.

The second class of inspection violations are those that result in a vehicle or driver being declared "out-of-service." These violations are considered severe enough to pose an imminent danger to the public. For drivers, out-of-service declarations are issued when the driver is in violation of hours-of-service regulations, or has not prepared a duty status record (logbook). A vehicle is declared out of service when by reason of its mechanical condition or loading it would be a likely cause of an accident or breakdown [U.S. Department of Transportation 1985]. Included are such items as defective tires, more than 40 percent of a vehicle's brakes out-of-adjustment, and defective trailer coupling devices. An out-of-service vehicle may not be driven, nor an out-of-service driver drive, until the applicable violations have been corrected.

Violations noted during MCSAP inspections must be corrected within 15 days of the inspection or before the start of the vehicle's next trip, whichever occurs first. Either the person doing the work or a carrier representative certifies repairs by signing the inspection report and returning it to the issuing agency.

Enforcement of Out-of-Service Penalties

As noted earlier, the stated objective of the MCSAP roadside inspection program is to remove from the highways those vehicles and drivers posing a threat to safety. To meet this objective, drivers and vehicles with severe violations are placed out of service until the deficiencies are corrected. The program, as operated in Pennsylvania, has two major limitations that impede attainment of this objective.

First, it is difficult to enforce compliance with out-of-service violations. Normally, it is impractical for an enforcement official to remain at the inspection site to ensure that deficiencies are corrected before the truck departs. If drivers leave before deficiencies are remedied—and some do—it is difficult to determine this fact and almost impossible to locate and arrest the violator.

Second, MCSAP violations are not included in the Non-Resident Compliance Compact (a reciprocal agreement between member states to honor each other's traffic citations and aid in enforcement), and thus citations issued for these violations are difficult to enforce on non-residents of the issuing state.

These two factors make the enforcement of out-of-service violations, especially those involving out of state vehicles and drivers, extremely difficult. Before MCSAP can become truly effective, methods for ensuring compliance with out-of-service declarations and improving nationwide enforcement of penalties must be established.

INSPECTION FINDINGS

The roadside inspections carried out under MCSAP are designed to identify vehicles and drivers with violations and defects most often cited as contributory factors in commercial vehicle accidents. Since these violations are considered the most likely causes of large truck accidents, our analysis of MCSAP inspection results will concentrate on them.

Tables 1 through 3 summarize three inspection programs: out-of-service violations uncovered during roadside inspections performed nationwide by the Bureau of Motor Carrier Safety during 1983 and 1984, those conducted in Oregon by the Oregon Public Utilities Commission during 1984, and those done by the involved agencies in Pennsylvania from August 1986 to March 1987.

In all three data sets, vehicle violations account for the overwhelming majority of out-of-service violations. The BMCS results indicate 82.1 percent of the out-of-service violations were vehicle related while the Oregon and Pennsylvania data show approximately 92.2 and 93.8 percent respectively [U.S. Department of Transportation 1985, Oregon Public Utilities Commission 1985]. By far, the most common vehicle defects involve vehicle brake systems. These defects account for more than 50 percent of all listed deficiencies. The second most common vehicle deficiencies involve vehicle lighting systems, with approximately 10 percent of the noted violations.

TABLE 1.

Out-of-Service Violations, BMCS Inspections, 1983-1984

Violation	Number	Percent
Brake System	8,620	51.0
Hours of Service/ Logbook	3,029	17.9
Lighting Systems	1,938	11.5
Tires	1,485	8.8
Suspension	548	3.3
All Other Deficiencies	1,269	7.5
Totals	16,889	100.0

Source: U.S. Department of Transportation 1985

TABLE 2.

Out-of-Service Violations, Oregon Inspections, 1984

Violation	Number	Percent
Brake System	5,131	63.4
Lighting Systems	745	9.2
Hours of Service/ Logbook	634	7.8
Wheels	534	6.6
Tires	531	6.6
All Other Deficiencies	515	6.4
Totals	8,090	100.0

Source: Oregon PUC 1985

TABLE 3.

Out-of-Service Violations, Pennsylvania, 1986-1987

Violation	Number	Percent
Brake System	14,257	69.0
Lighting Systems	2,181	10.6
Hours of Service/ Logbook	1,291	6.2
Tires	1,279	6.2
Suspension System	485	2.4
All Other Deficiencies	1,153	5.6
Totals	20,646	100.0

Source: PennDOT MCSAP Quarterly Reports

Driver related out-of-service violations are noted much less often than vehicle violations. The BMCS inspections identified approximately 18 percent of all violations as driver related, while the other two programs recorded less than 10 percent of the total out-of-service violations against drivers.

This unequal distribution of out-of-service violations between vehicles and drivers reflects the design of the inspections themselves. The majority of items for which an out-of-service declaration can be issued are vehicle related. Drivers can only be declared out-of-service for violating hours-of-service regulations and/or failing to have their logbooks correctly completed.

CAUSES OF HEAVY TRUCK ACCIDENTS

As stated, traffic accidents are difficult to attribute to any one particular cause. Accidents are more likely to occur when the current conditions of the vehicle, driver, and the environment exceed the "margin of safety." The event usually cited as the cause of an accident is the one that finally reduces the "margin of safety" to the point where the accident occurs [Clarke et al., p. 4].

The factors contributing to heavy truck accidents can be divided into those attributed to the truck, those attributed to the environmental conditions, and those attributed to any other vehicles involved. Approximately 10 percent of the accident causes can be attributed to outside conditions existing at the time of the accident. The remaining causal factors are about evenly divided between the trucks and the other vehicles involved [Oregon Public Utilities Commission, Vallette et al. 1981, Pennsylvania Department of Transportation].

The truck attributed factors can be further subdivided into driver-related (speeding, fatigue, inattention, alcohol use) and vehicle-related (defective brakes, blown tires). These two categories are examined in this study.

Vehicle-Factors in Heavy Truck Accidents

Defective truck equipment is noted as a cause in only a fraction of large truck accidents. During 1986, accident data for Pennsylvania indicated that vehicle defects accounted for only 13 percent of all the culpability factors assigned to trucks [Pennsylvania Department of Transportation]. Other reports revealed a lower percentage of vehicle factors contributing to truck accidents. These figures range from a low of 6.4 percent reported in 1973 [Eicher, Robertson and Toth] to 13.1 percent in 1984 [Oregon Public Utilities Commission].

The vehicle factor mentioned most often in large truck accidents is the failure of the brake system. In Pennsylvania during 1986, brake failures accounted for approximately 3.5 percent of the truck-attributed accident causes. During this period, overloading/load shifts were the second most common vehicle factor (2.9 percent) followed by tire blowouts (1.0 percent). All other vehicle factors were mentioned less than 1 percent of the time. Table 4 presents the number and percentages of those truck-related factors accounting for at least 1 percent of the causal factors.

Driver-Related Factors in Large Truck Accidents

An examination of truck-related factors in accidents reveals a striking point. The overwhelming majority of the truck-related causal factors are attributed to the truck drivers. This majority is substantial, ranging from 80 to 90 percent of the total contributory factors [Oregon Public Utilities Commission, Pennsylvania Department of Transportation]. Other studies have also indicated that in more than 90 percent of truck accidents no mechanical defects were reported as a cause [U.S. Department of Transportation 1986].

Furthermore, if only *preventable* accidents (those that could have been prevented by the action of any involved party or the removal of a road hazard) and their causes are studied, the percentage of driver-related factors increases even more [Boyar et al. 1985]. A study conducted for the Federal Highway Administration concluded that 68 percent of commercial vehicle accidents were preventable. The report further states that "professional driver failures were the prime cause in 94.5 percent of the preventable accidents, and vehicle failures were the prime cause in 5.1 percent [Boyar et al., p. 27]."

As displayed in table 4, ten of the most common, and the first seven, causal factors attributed to the trucks in heavy truck accidents are driver related. The most common factor was tailgating on the part of the truck, followed closely by improper turning and excessive speed. Overall in Pennsylvania during 1986, 87 percent of the total truck-related causal factors were attributed to the drivers [Pennsylvania Department of Transportation].

Accuracy of Truck Accident Data

It has been pointed out that these figures may be somewhat misleading since they are taken from accident reports. These reports are often completed by the truck owners or else taken from accident reports completed by investigating officers both of whom may be inadequately trained in truck accident analysis techniques. Because of this, it is argued, vehicle defects are not usually reported unless they are an obvious cause of an accident.

A study of tractor-trailer crashes conducted in Oregon concluded that 41 percent of the accident-involved trucks included in the study had defects severe enough to be an out-of-service violation under MCSAP [Stein and Jones 1987]. This figure, somewhat higher than the out-of-service percentage usually associated with roadside inspections, may reflect the more stringent inspection performed on a vehicle that has been involved in an accident. Whether the defects contributed to the accidents, or if the defects were mentioned on the associated accident reports, is not clear.

TABLE 4.

Truck-Related Factors Contributing to Large Truck Accidents, Pennsylvania, 1986

Causal Factor	Number	Percent
Tailgating	459	11.6
Improper Turns	458	11.6
Speeding/Too Fast for Conditions	449	11.4
Careless Lane Change	221	5.6
Sudden Stopping/Slowing	204	5.2
Driving on Wrong Side	172	4.4
Driver Distracted	142	3.6
Brake System Failure	137	3.5
Careless/Improper Passing	133	3.4
Overloading/Load Shift	114	2.9
Lost Control	85	2.2
Driver Asleep, Drowsy, Fatigued	76	1.9
Tire Blowout	38	1.0
All Other Factors	1,249	31.7
Total	3,937	100.0

Source: PennDOT, Statistical Summary Report, 1986

COMPARISON OF INSPECTION FINDINGS AND ACCIDENT CAUSES

The major supposition underlying roadside inspections of commercial vehicles is that by uncovering vehicle and driver deficiencies, accidents can be prevented. The inspections, as designed and conducted, are more apt to uncover vehicle, as opposed to driver, deficiencies.

Out-of-service violations, those considered most likely to be a cause of a large truck accident, are predominantly vehicle related. The relative percentages of vehicle-related deficiencies noted during the inspections are reflective of the causes of large truck accidents. This is indicative of the ability of these inspections to uncover vehicle-related defects. Driver conditions that pose an imminent danger are a different matter.

Less than 10 percent of deficiencies cited during roadside inspections are driver related. The only driver-related deficiencies serious enough to warrant out-of-service declarations are those involving violation of hours-of-service and logbook documentation regulations. Fatigue from driving excessive hours may contribute more to heavy truck accidents than roadside inspection and accident data indicate.

The truck accident data from Pennsylvania indicate that only 1.9 percent of the driver-attributed factors resulted from fatigue [Pennsylvania Department of Transportation]. Among preventable truck accidents, 2.3 percent of the causes were attributed directly to fatigue [Boyar et al.]. Many of the other driver-related factors in heavy truck accidents may also reflect some degree of fatigue on the part of the driver.

The recent Regular Common Carrier Conference study indicates that in excess of half of all truck drivers regularly violate mandated hours-of-service regulations [Beilock 1987]. Another study estimates that possibly 40 percent of heavy truck accidents have truck driver fatigue as a contributing factor [Transportation Research]. Additional research has indicated that there is a decrease in the alertness level of truck drivers can occur well within the hours-of-service limits set by current regulation [Harris et al. 1972].

Current inspection procedures only check the drivers' logbooks for completeness. No attempt is made to ascertain the accuracy of the logbooks' contents. Compounding this is the difficulty of determining how fatigued a driver actually is. For example, a driver may have a logbook that accurately portrays his duty status but does not reflect his activities before going on duty. This driver, while not having an inspection violation that would place him out-of-service, may be experiencing the long-term effects of fatigue that do increase the potential of his being involved in an accident. Roadside inspections, as now performed, do not provide an effective means to remove fatigued drivers from the highway.

EFFICACY OF ROADSIDE INSPECTIONS

Roadside inspections of heavy trucks, as currently conducted, provide a useful tool for enforcement officials to remove some potentially unsafe vehicles from the highway. They do not, however, effectively address driver-related factors that contribute to heavy truck accidents. The belief that roadside inspections will play a significant part in reducing heavy truck accidents has not been borne out. U.S. Department of Transportation accident data show no decrease in either the number of heavy truck accidents or their associated fatalities since the inception of MCSAP inspections nationwide [Report of the Committee on Commerce, Science, and Transportation, p. 49]. Improving truck safety is of prime national concern. Whatever strategies are implemented, they must be directed at all aspects of truck safety. This includes carriers, shippers, and the general motoring public as well as trucks and truck drivers.

SUMMARY OF ANALYSIS

Following are the findings concerning roadside inspections of large trucks and truck involvement in traffic accidents resulting from this study:

1. More than 80 percent of out-of-service violations cited on roadside inspections are vehicle related.
2. More than 50 percent of all out-of-service violations are for defective or improperly adjusted brake systems.
3. Driver out-of-service violations account for less than 20 percent of all out-of-service violations cited during roadside inspections. Of these, all are related to hour- of-service or logbook violations.
4. Improper actions on the part of the driver account for more than 80 percent of the truck-attributed factors in heavy truck accidents.
5. In preventable heavy truck accidents, vehicle failures were listed as the prime cause only 5 percent of the time.
6. Approximately 2 percent of driver-attributed factors in heavy truck accidents are directly related to driver fatigue.

RECOMMENDATIONS

Improving motor carrier safety is not an easy task. Programs directed at only a portion of the overall problem—such as roadside inspections—will do little to attack root causes of the overall problem. Improvements will only result from comprehensive programs that do address the root causes. Figure 2 presents a matrix of possible strategies for improving heavy truck safety.

The following recommendations are directed at reducing the severity of the problems noted in this study:

1. At the margin, an increase in enforcement activities directed toward identifying and citing truck drivers who operate vehicles in an unsafe manner may prove more cost effective than roadside inspections in reducing the number and severity of large truck accidents.

The disparity between the documented findings of roadside inspections and the causes of large truck accidents casts some doubt on the efficacy of roadside inspections as a means to reduce heavy

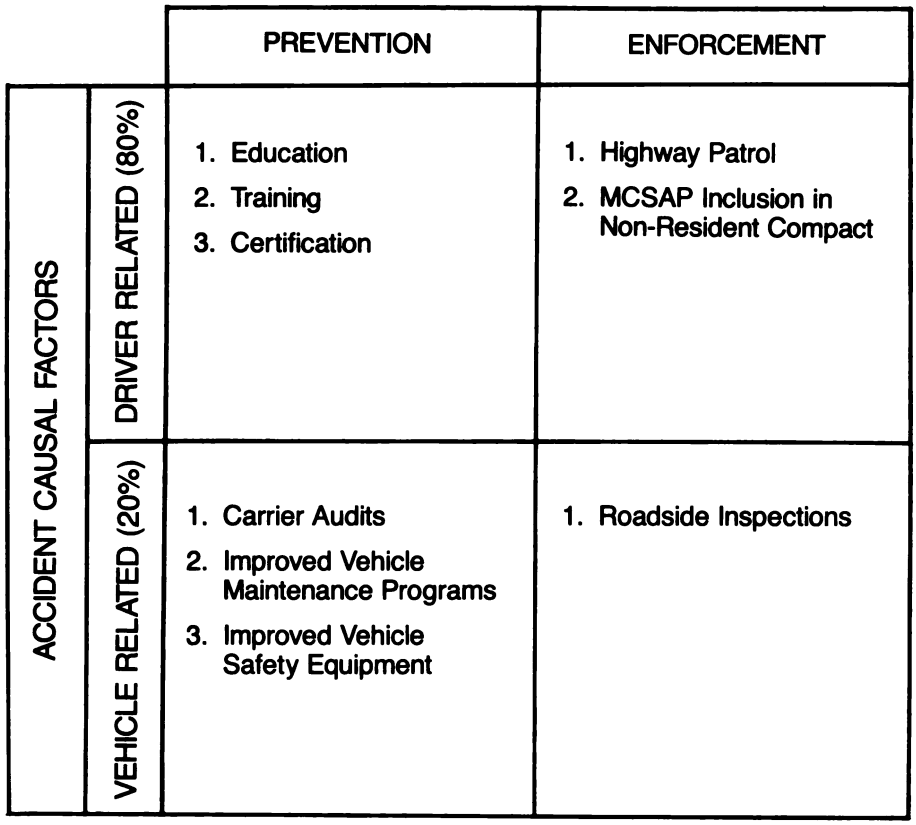

FIGURE 2. Strategies for addressing truck related factors in heavy truck accidents.

truck accidents. A sound safety program clearly needs to address the unsafe actions of drivers as well as the potential hazards of operating defective vehicles.

2. Additional research is needed to ascertain the prevalence of fatigue as a factor in heavy truck accidents. The research should also attempt to accomplish three other goals: determine the extent to which drivers violate the current hours-of-service regulations; provide additional strategies to identify those drivers who are in violation of applicable hours-of-service regulations; and supply recommendations for modifying roadside inspection programs to increase inspectors' ability to identify the violators.

3. One method to ensure that a new commercial driver meets minimum qualification standards is to require the completion of a certified commercial driver's training program before a license is issued. Although driver error will never be eliminated as a cause of accidents, properly trained and qualified truck drivers can help to reduce accidents. The Commercial Vehicle Safety Act of 1986 mandated that nationwide standards for the issuance of the commercial driver's license be established. The act also stated the minimum qualifications a driver must possess before operating a commercial vehicle.

4. To further aid in the enforcement of penalties associated with MCSAP violations, the Non-Resident Compliance Compact should be amended to include MCSAP provisions. Research to determine how many inspectors must leave before seeing if MCSAP out-of-service violations are corrected would improve the overall effectiveness of roadside inspections. If a serious problem exists, a system should be developed to ensure that out-of-service vehicles remain out-of-service until violations are corrected.

5. Further research into the applicability of joint responsibility for violations may provide enforcement agencies with a further method to induce the trucking industry to increase its overall safety efforts. Carriers are ultimately responsible for the quality of the vehicles and drivers they employ. Many of the violations noted during MCSAP and other roadside inspections could be eliminated or reduced in severity by comprehensive vehicle maintenance programs and close supervision of drivers.

Many truckers also complain that they are being hampered in complying with safety regulations by the demands made by shippers. In particular, delivery deadlines that force drivers to break hours-of-service and speed regulations are often cited as major detriments to truck safety [Beilock, 1987 and 1985]. Unless shippers agree to timetables that allow trucks to be driven within the law while ensuring a profitable return to truckers, the industry's safety record will be difficult to improve. Beilock's study concerning the pressures of meeting delivery deadlines, has suggested joint culpability for carriers, shippers, brokers, and receivers if schedule demands require violation of applicable regulations.

6. Further research should be conducted into the desirability and effectiveness of requiring antilock brakes and on-board monitoring devices on all commercial vehicles. Improvements in vehicle equipment specifications can also have a positive impact on safety. Two items in particular are often cited as adding to the safety of commercial vehicles. Antilock brakes are considered an excellent method to improve the overall stopping ability of large vehicles [Clarke et al., p. 92]. Requiring these brakes on heavy trucks may help to reduce the number and severity of brake-related accidents.

On-board monitoring devices may also prove useful in controlling speed and driver hours-of-service violations. The Federal Highway Administration has recently indicated that these devices are as effective as the handwritten logs currently maintained by truck drivers [*Traffic World* 1988]. Tests conducted by several trucking firms have also shown that these devices can help carriers improve productivity [*Traffic World*, Abruzzese 1987, Lelyveld 1987].

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ENDNOTES

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