Chapter 6
Human Factors in Truck Safety

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Trainees watch an instructor demonstrate how to back up a truck.

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Heavy vehicle drivers must continuously process and react to a variety of information, and even momentary lapses in concentration can cause an accident. The behavior of other drivers, the vehicle, roadway design, and the traffic environment all can distract the driver, as can other factors such as carrier management attitudes and policies or economic and scheduling pressures. Human error is cited as the cause of over 60 percent of motor carrier accidents.

Although the Federal Government has focused on some aspects of vehicle and highway design, it has given inadequate attention to the interacting and subtle human factors that affect motor carrier safety. This chapter describes driver performance and explores the relationship between human factors and truck safety, describing industry safety programs and identifying Federal policy options.

THE DRIVER

The typical human information processing sequence includes receiving information, recognizing and evaluating it, reaching a decision, and taking action—all within a very short time period. (See figure 6-1.) An alert driver can process information in less than 2 seconds when confronted with an unexpected hazard in the roadway.[1] However, fatigue or other impairment affects both the speed of the driver's mental processes and the accuracy of his judgment.[2] The continual changes in the roadway environment and the special skills required in stopping and maneuvering heavy trucks suggest that a competent heavy truck driver should be well trained, experienced, and alert.

Driver Screening

Driving a heavy vehicle demands greater skills than operating a passenger car, both in normal driving situations and in responding to potential hazards.[3] Heavy trucks are less easily maneuvered than automobiles, requiring greater distances for passing, stopping, turning, and accelerating, and forcing drivers to anticipate and avoid potential traffic conflicts. Thus, a safety conscious carrier manager will take seriously the task of identifying and hiring drivers with appropriate skills, attitudes, and training.

U.S. Department of Transportation (DOT) requirements for carrier hiring procedures are broad enough to permit wide variations in company practices. All driver applicants must complete a written application and must take a road test and a written test. However DOT gives no clear guidelines for what constitutes "passing" either test. In fact, DOT does not require that the knowledge test be passed, only that the applicant be told the correct answer for the items missed. (For further details on requirements, see chapter 3.) In practice, even these regulations are ignored by some carriers or interpreted with considerable latitude. Commercial Driver's License Program[4] tests will determine whether a prospective driver has the minimal level of skills to operate a heavy truck. However, the carrier management's evaluation of a driver's background and skills will remain the dominant hiring standard.

Many carriers devote careful attention to driver hiring, requiring reference checks, referrals, drug screening, and interviews, over and above the back-

[1] P. D. Olsen et al., *Parameters Affecting Stopping Sight Distance,* NCHRP Report No. 270 (Washington, DC: Transportation Research Board, 1984).

[2] M. Allnutt "Human Factors: Basic Principles," *Pilot Error, The Human Factors*, R. Hurst and L. Hurst (eds.) (London, England: Granada Publishing, 1983).

[3] Transportation Research Board, *Zero Alcohol and Other Options: Limits for Truck and Bus Drivers*, Special Report 216 (Washington, DC: National Research Council, 1987).

[4] Commercial vehicle operator licensing was changed dramatically by passage of the 1986 Commercial Motor Vehicle Safety Act, but the gradual phasing in of the program will delay the full impact of the legislation. The Commercial Driver's License Program of the Department of Transportation established five key dates as milestones for identifying and removing unqualified drivers from the road. For further information on the program, see ch. 3.

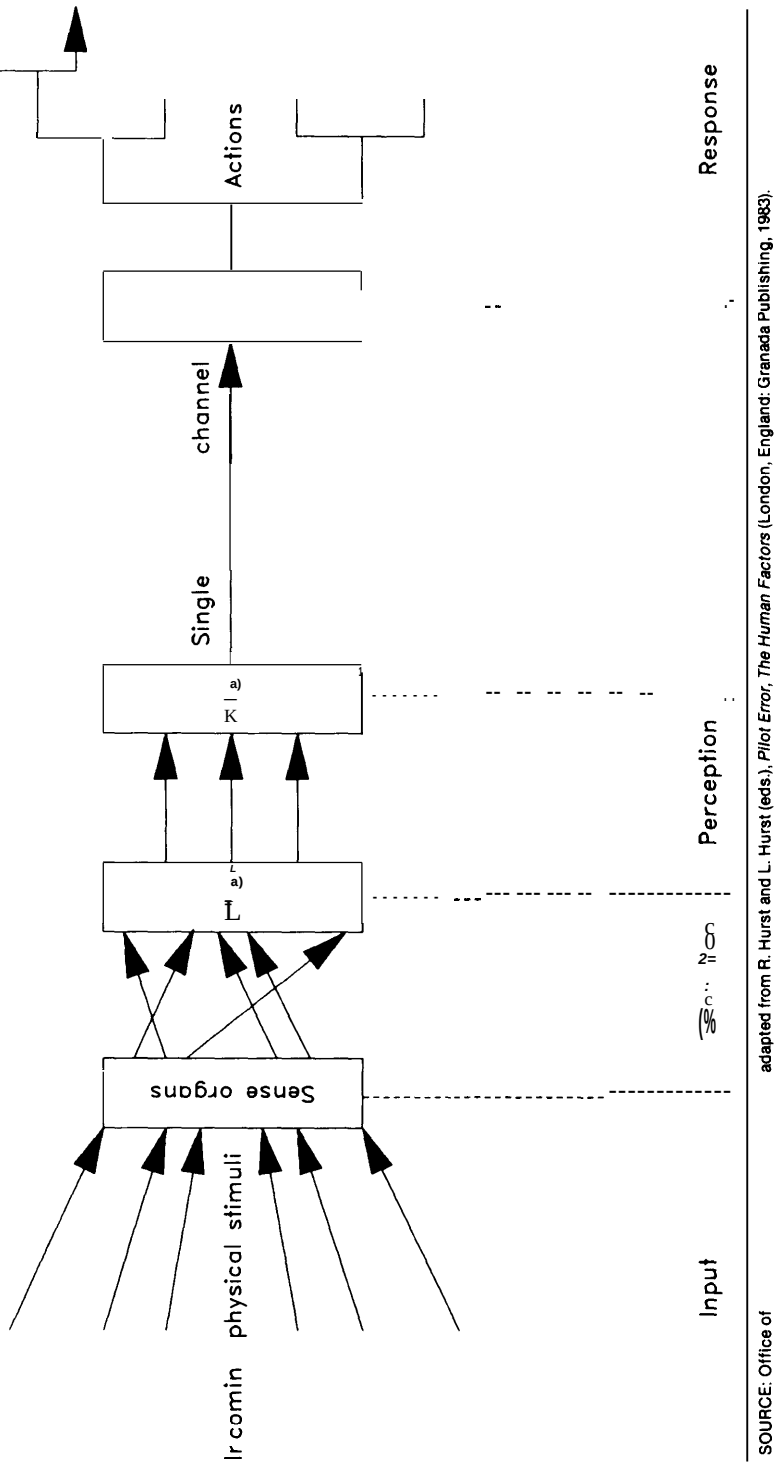


Figure 21.1 Human Information Processing Sequence

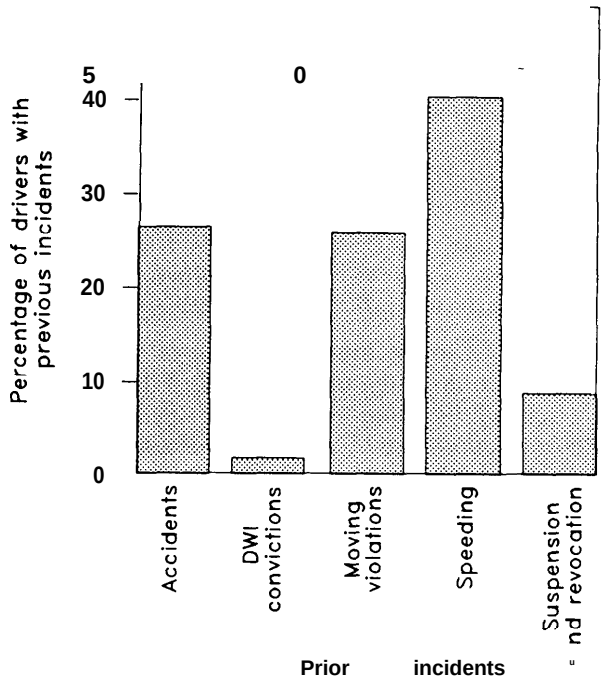
SOURCE: Office of adapted from R. Hurst and L. Hurst (eds.), *Pilot Error, The Human Factors* (London, England: Granada Publishing, 1983).

ground checks and pre-employment physical examinations that DOT requires. Thorough prehiring evaluation can pay major dividends for management. One company uses a carefully developed test to help determine which applicants have the coordination, physical capability, and mental attitude to handle a tractor-trailer combination. The company has found a very strong correlation between the driving skill level exhibited during the evaluation and driver performance after hirings Moreover, when a driver eventually does have an accident, the cause is frequently a driving behavior characteristic that the test had identified as needing improvement. Such a diagnostic tool can provide a carrier with invaluable information to use in both initial driver training and retraining.[6]

Automotive safety research shows that those who indicate on a screening test that they are risk-takers are likely to be relatively aggressive in their driving behavior, less mindful of cautions about safety, and more likely to drive longer hours without rest. On the other hand, risk averse drivers, though not necessarily more skilled, are likely to give other highway users a way out in dangerous road situations and to show prudence in their driving decisions.[7] However, not all carriers understand the benefits of careful screening—a DOT study of carriers rated unsatisfactory in the Pacific Northwest found that 35 percent of the firms had unsatisfactory driver qualification procedures.[8]

Although driving a truck requires different skills than driving a car, one study that examined the relationship between a truck driver's driving records in his personal vehicle and in his truck found a strong similarity between the records. OTA analysis of the National Accident Sampling System data also shows that heavy truck drivers involved in accidents have received citations for previous safety violations, particularly for speeding (see figure 6-2). However, the prior record in the truck is a better predictor than either the record in the private vehicle or the total record including both private and commercial driving.[9]

Figure 6-2.-Incident History of Heavy Truck Drivers Inveled in Accidents



KEY: DWI = Driving while intoxicated.
SOURCE: Office of Technology Assessment, 1988; based on National Accident Sampling System data.

Management interest in more stringent screening procedures may be thwarted by demographic and economic pressures. The Department of Labor reports that the truck driving work force is expected to increase 17.2 percent by 1995, placing truck driving among the 37 fastest growing occupations out of 500 studied.[10] At the same time, industry analysts forecast that finding qualified truck drivers will become more difficult over the next decade, with a 30-percent reduction in the available driver pool expected by 1992. This reduction will be due to retirements, drug screening, tighter Federal driver requirements and licensing standards, a shrinking national labor force, and the perception that truck driving is a high-stress job requiring excessive time

[5]John Dannemiller, Leaseway Transportation Corp., in U.S. Congress, Office of Technology Assessment, "Transcript of Proceedings—OTA Workshop on Human Factors and Truck Safety," unpublished transcript, May 19, 1987, p. 43.

[6]Fred E. Vanosdall, Michigan State University, personal communication, May 18, 1988.

[7]Richard Schwing, General Motors Research Laboratories, in Office of Technology Assessment, op. cit., footnote 5.

[8]Robert Bleakley, Federal Highway Administration, in Office of Technology Assessment, op. cit., footnote 5, p. 65.

[9]Shirley B. Geissinger et al., *The Relationship Between a Truck Driver's Performance in a Personal Vehicle and in a Large Truck* (Chapel Hill, NC: University of North Carolina, Highway Safety Research Center, June 1986).

[10]National Transportation Safety Board, *Training, Licensing and Qualification Standards for Drivers of Heavy Trucks*, Report No. NTSB/SS-86/02 (Washington, DC: Apr. 17, 1986), p. 5.

away from home.[11] Truck driver wages rose just over 20 percent between 1979 and 1987, as compared to a rise of almost 50 percent for all occupations.[12]

To meet its needs, industry may have to resort to nontraditional labor sources, such as women and minorities, and increase wages. Recent proposals to allow 18- to 20-year-oIds to operate commercial vehicles and heavy trucks as on-the-job trainees are a result of the shrinking driver pool. These proposals raise safety concerns, since accident statistics point directly at young drivers as a high-risk group.

Thus, although the importance of the selection process in screening out unqualified drivers is well recognized by many carriers, the need for personnel may cause the numbers of problem drivers behind the wheel to grow. Steps may be required to bolster application of uniform and stringent driver selection practices throughout the industry.

Alcohol and Drug Use Among Drivers

Although currently being revised, Federal Motor Carrier Safety Regulations now prohibit possessing, being under the influence of, or using an intoxicating beverage or drug while on duty, or consuming an intoxicating beverage within 4 hours of going on duty. Furthermore, a person is not qualified to drive if he or she has a current clinical diagnosis of alcoholism or drug dependency. These rules were based on the knowledge that driving performance is directly affected by intoxication or the influence of drugs. While the reaction to the ingestion of drugs and alcohol varies depending on the individual,[13] studies show that, for the majority, human performance is degraded by blood-alcohol concentration (BAC) levels of 0.05 or even lower. Epidemiological studies also indicate that the risk of being involved, as well as at-fault, in a motor vehicle accident begins increasing at low BAC levels.[14] This is in contrast to a legal standard for intoxication in highway driving currently set at 0.10 BAC in most States.[15]

Many of these research findings are based on automobile driving performance, and heavy vehicle drivers operate more complicated equipment on roadways often designed for smaller vehicles. Previous studies suggest that although more skilled persons are better able to compensate for the effects of alcohol than those less skilled, even skilled drivers show a decreased ability to handle complex tasks at low BAC levels.[16] Data analysis clearly correlates drinking with truck accident severity (see figure 4-6 in chapter 4). Recognizing the dangers of alcohol consumption and driving, one large petroleum refining company that sells fuel to truck stop operators has written provisions into its service contracts forbidding the sale of alcohol at those stops.[17] Alcohol use is a problem that cuts across driver classifications as shown in tables 6-1 and 6-2.

[11] Jim Windsor, "Serious Accidents: Manpower Shortages vs. Driver Quality," *Heavy* Duty Trucking, July 1987, p. 18.

[12] Joanne F. Casey, American Trucking Associations, Statistical Analysis Department, "An Assessment of the Truck Driver Shortage," unpublished manuscript, Aug. 10, 1987, p. 7.

111. c. Drew et *al., Effect of Small Doses of Alcohol on a Skill Resembling Driving* (London, England: Her Majesty's Stationary Office, 1959).

[14] Transportation Research Board, op. cit., footnote 3, p. 40.

[15] If the Secretary of Transportation does not issue a regulation by October 1988, the blood-alcohol concentration for commercial vehicle drivers will automatically drop to 0.04, consistent with present regulations for aviation crews and railroad engineers.

[16] Transportation Research Board, op. cit., footnote 3, p. 57.

[17] Gisela Vallandigham, vice president of membership, National Association of Truck Stop Operators, personal communication, Mar. 15, 1988.

Table 6-1.—Drinking-Related Accidents by Driver Classification

	Number of drivers	
	Drinking involved	Drinking not involved
Noncommercial	856	90,234
Full time	3,555	579,260
Part time	205	27,100
Owner-operator	518	66,996
Leased	546	11,832
Other	303	2,319

SOURCE: Office of Technology Assessment analysis of National Accident Sampling System data, 1981-85.

Table 6-2.—Drinking-Related Accidents by Carrier Classification

	Number of drivers	
	Drinking involved	Drinking not involved
Noncommercial	856	90,234
For-hire/common	856	179,662
For-hire/contract	1,258	194,806
Private	1,932	242,130
ICC Exempt	1,142	51,770
Other	151	20,163

SOURCE: Office of Technology Assessment analysis of National Accident Sampling System data, 1981-85.

Evaluations of other drug-related impairment levels are far more primitive. Reliable evidence about the effects of drugs on drivers is sketchy, and most States do not test for drugs other than alcohol. Further research on the subject is needed for marijuana and other controlled substances before adequate impairment guidelines can be established. The National Transportation Safety Board (NTSB) hopes to establish some guidelines for impairment levels as part of its current drug and alcohol study; the study is currently scheduled for completion in 1989.[18]

Drug Testing

Many carriers require pre-employment drug and alcohol testing. When one company started a drug-alcohol testing program 2 years ago, 15 percent of the applicants tested positive in the first year.[19] A year later, only 8 percent of applicants tested positive; this company had sent a signal to prospective drivers that they need not apply if they have a drug or alcohol problem. Such individuals may seek employment from other carriers with different screening policies; indeed, one company in the Midwest reported that 47 percent of the applicants it screened had positive drug screens. Another carrier that conducted drug screening of current employees and job applicants found that 17 percent of the tests were positive.[20]

Where management fails to take assertive action, the drug problem among employees can become entrenched. For example, one motor carrier safety director found evidence of marijuana use while making spot checks of his company's tractors. A subsequent investigation led to the discharge of 50 percent of the drivers at the terminal involved. In another instance, a laboratory that performs drug screening for several major carriers found that even for repeat examinations, 13 to 18 percent of the tests were positive. In some cases, this occurred despite the fact that employees were given 30 to 60 days advance notice of the tests.[21] OTA staff found that drugs are readily available at truck stops, some of which are well-known among drivers for drug activity, and CB radios are used openly for advertising or soliciting drugs.[22]

Appropriate formal procedures for periodic drug and alcohol testing of employees have been the subject of much debate. Many motor carriers conduct testing on a calendar basis for all employees; others test a sample of employees.[23] The International Brotherhood of Teamsters' master freight agreement guidelines for physical examinations and for testing urine for marijuana and other classes of drugs generally follow standards set by the U.S. Department of Health and Human Services. Members can be tested during their regular DOT physical examinations and when probable suspicion or cause can be established.[24] Although the Teamsters represent many drivers working for large trucking concerns, the majority of drivers are not subject to this agreement. When an independent driver contracts with a larger carrier, however, he must abide by that company's policy. It has been estimated that carriers large enough to mount their own alcohol and drug abuse programs are responsible for less than one-third of the heavy trucks using the highways.[25]

In a survey of 1,762 truck drivers conducted recently in Florida, 33 percent of the drivers reported being previously tested for alcohol, and 38 percent reported being previously tested for drugs by the company they were presently driving for or to which they were leased. Owner-operators reported the lowest frequency of testing, 29 percent for alcohol and 31 percent tested for drugs, respectively. Drivers employed by for-hire carriers reported the largest percentage of prior testing. Attesting to concern about substance abuse among drivers, 73 percent of those surveyed stated that they support mandatory random alcohol and drug testing by employers.[26]

The reliability of the testing methods is of special concern for drug tests. The most accurate tests,

[18] Pat Loach, project director, National Transportation Safety Board, personal communication, Mar. 18, 1988.

[19] Ken Thompson, Yellow Freight System, Inc., in Office of Technology Assessment, op. cit., footnote 5, p. 147.

[20] Richard Landis, Associate Administrator for Motor Carriers, testimony before the Senate Committee on Commerce, Science, and Transportation, Feb. 18, 1986.

[21] Ibid., p. 28.

[22] An OTA analyst made several trips with over-the-road drivers in conjunction with this project.

[23] Thomas Donohue, President and CEO, American Trucking Associations, testimony before the Senate Committee on *Commerce*, Science, and Transportation, Feb. 18, 1986.

[24] Transportation Research Board, op. cit., footnote 3, p. 132.

[25] Ibid., p. 132.

[26] Regular Common Carrier Conference, "Highway Common Carrier News Release," Nov. 16, 1987.

which are also the most expensive ($30-$125), can produce 2 to 3 false positives per 100 tests. Because of the likelihood of false readings, laboratory experts urge a followup test. While many cost-conscious employers are not willing to pay for additional tests, others share information with the applicant and will re-evaluate the applicant if he or she takes a second test at personal expense.[27]

Some companies are sensitive to the counseling needs of drug and alcohol abusers. One carrier's employees are given a drug test as part of their annual physical examination; they are notified of their scheduled appointment 30 days in advance. The company feels a responsibility to assist the driver in obtaining treatment if the employee informs management prior to the physical of a drug or alcohol problem.[28]

More stringent methods for detection of alcohol use by truck drivers while on the road have also been discussed as enforcement measures. A recent study conducted by the Transportation Research Board (TRB) concluded that the technical ability to detect and measure BAC levels of less than 0.05 is available with current screening and testing devices. However, the legal authority of public enforcement officers to enforce a law based on a low BAC standard with breath-screening devices has not been definitively established. If the ability to do so survives legal scrutiny, the TRB report indicates cost-effective enforcement could be carried out by screening drivers at truck weigh stations and as part of vehicle safety inspections. Blood tests could be mandatory after injury-producing accidents. TRB estimates that vigorous enforcement of this kind would save between 80 to 140 lives annually at a minimum BAC level of 0.10, 110 to 190 lives at a 0.04 BAC threshold, and 130 to 250 lives at a limit of 0.00 BAC. The total public and private costs for enforcement at each level is estimated at $30 million, $40 million, and $50 million, respectively .29

[27]Greg Borzo, "Motor Carriers Institute Pre-Employment Drug Tests," *Traffic World*, June 15, 1987, p. 12.

[28]Ken Thompson, Yellow Freight System, Inc., in Office of Technology Assessment, op. cit., footnote 5, pp. 147-148.

[29]Transportation Research Board, op. cit., footnote 3, p. z.

MANAGEMENT APPROACH

Driver attitude is a major influence on truck safety and that attitude is affected by company management philosophy and the work environment. A carrier that actively promotes safety and rewards good practices establishes safety as a major driver responsibility. This approach often requires extra effort to develop staff leadership and provide safety incentives; however, under such management, drivers are more likely to view themselves as professionals, accountable for the safe operation of their vehicles. Incentive programs may include cash bonuses, award programs, group recognition, and distribution of patches, pins, wallet cards, rings, and even stock for different levels of achievement.

One firm has adopted a formal corporate approach to safety that focuses on: 1) driver selection, 2) driver training, 3) driver conditioning, and 4) driver management.[31] Communication is an important safety ingredient at another firm. **For instance, group discussions between management and drivers encourage driver feedback and provide management with constructive information about operations. Good rapport between labor and manage-**

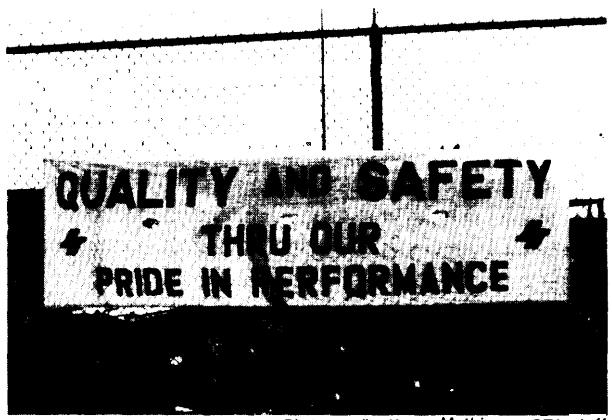


Photo credit: Karen Mathiasen, OTA staff

Management emphasis on safety can focus drivers on its importance.

[30]John J. Killilee, Consolidated Freightways, in Office of Technology Assessment, op. cit., footnote 5, p. 152.

[31]Dannemiller, op. cit., footnote 5, pp. 42-46.

ment brings better agreement about organizational goals and how to achieve them.

One management consulting company has **developed a program to establish a positive corporate attitude toward safety through management strategies, technical training, and operations. The program addresses vehicle inspection, driver selection, drug screening, driver health, hazardous materials hauling, city and over-the-road driving, hours of service, accident reporting, worker's safety, and security.[32] Another company that produces industry-related instructional material is developing a series of video-training programs on trucking. Safety programs will cover driver fatigue, road vision, driving a bobtail with an empty trailer, and professionalism. Technical training programs will include brake systems, motors, truck specifications, and gauges and switches. Numerous other trucking associations and commercial firms also publish training materials. No widely accepted standards exist for evaluating any of these programs.**

Companies that have mounted carefully structured and intensive safety efforts have found major cost benefits in the quality of customer service, productivity improvements, and accident avoidance leading to lower insurance costs.[34] United Parcel Service (UPS), one of the most successful carriers in the country, is such a company, and its accident rate is one-tenth the national average. Box 6-A describes UPS operations and safety management techniques.

Creating an environment that does not compromise safety requires management to balance regulatory requirements, such as hours-of-service rules, and customer service needs—just-in-time deliveries, for example. Intense competition for freight and market share provides a powerful incentive to increase productivity, utilize capacity, and push drivers to the limit of their ability to stay alert at the wheel. Some companies inform customers directly that trade-offs exist between costs and quality of service, and that safe, reliable service is worth slightly higher rates.[35]

However, drivers complain that shippers, brokers, and dispatchers often push hard for unrealistic delivery schedules that violate regulations. While an oversupply of carriers in the mid-1980s enabled shippers to shop around for carriers willing to take a load on any terms, this is less true today. Nonetheless, drivers resent being held responsible for violations of weight laws or hours-of-service regulations. The American Trucking Associations, inc. (ATA) advocate placing responsibility directly on shippers for demanding that truckers drive longer or faster than is legal to deliver goods.[36] Others claim that the need to use brokers places additional constraints on both shippers and carriers.[37] The State of Rhode Island has acknowledged that drivers are often subject to strong pressure from carrier management and imposes fines and citations for motor carrier owners whenever their drivers are cited.[38] One expert finds that drivers feel less pressured to take loads exceeding weight limits in States where this change in policy has occurred.[39]

The Federal Highway Administration (FHWA) has two small, new programs that address similar issues. The Commercial Accident Prevention and Evaluation Program was started in 198? to identify carriers with high at-fault accident rates and develop countermeasures to reduce risks. The Educational and Technical Assistance Program is a nationwide safety information program aimed at carriers, drivers, and industry associations. Mass mailings of literature identify highway locations with high accident rates and detail accident avoidance techniques.[40]

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[32] Jay Deragon, president, Megasafe, personal communication, Oct. 12, 1987.

[33] Bernadette Williamson, senior producer, The Kalamazoo Writing and Video Co., Merv Orr's Transportation Training Corp., personal communication, Feb. 25, 1988.

[34] Robert D. Powell, vice president, Finance, Arthur H. Fulton, Inc., personal comunication, Jan. 26, 1988.

[35] Dannemiller, op. cit ", footnote 5, p. 46; and ibid.

[36] Donohue, op. cit, footnote 23, p. 50.

[37] James Johnston, Owner-Operators Independent Drivers Association of America, in Office of Technology Assessment, op. cit., footnote 5, pp. 240241.

[38] William Maloney, associate administrator for motor carriers, Rhode Island Public Utilities Commission, personal communication, Feb. 2, 1987.

[39] Patricia Wailer, University of North Carolina, Highway Research Center, personal communication, May 19, 1987.

[40] Robert Bleakley, Federal Highway Administration, personal communication, July 6, 1988.

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DRIVER TRAINING

OTA accident data analysis shows that level of driver training is the second most frequently cited factor for motor carrier accidents. Although reliable statistics do not exist, industry experts estimate that the majority of drivers have not had adequate formal training. Research indicates that experienced drivers often acquire bad driving habits that could be corrected through remedial or inservice training. A number of carriers have recognized the importance of thorough training and have developed their own programs, described later in this section.

At present, no Federal requirement exists for drivers of heavy trucks to receive formal training, nor does a single State impose a training requirement for all drivers of heavy trucks.[41] Federal regulations for the Commercial Driver's License establish qualifications on the basis of whether a person can safely operate the vehicle and secure the load to be carried, skills that can be acquired through either training or experience. Many motor carriers do not impose specific training requirements, but require applicants to have a minimum of 2 years of on-the-road experience.[42] This poses difficulties for graduates of accredited training programs, since the only way to meet this demand is to drive for a firm that has no such requirement.

Formal truck driver education is available through proprietary truck driver training schools, nonprofit public education institutions, and in-house motor carrier training programs. The number of proprietary training programs is estimated at around 200, with fewer than 10 being in-house programs. Tuition ranges from $350 to $5,000. Course length, qualifications of the instructors, student/teacher ratios, and, most importantly, time spent on the road driving vary widely among programs.[43] A survey of truckers in Florida indicated that 23 percent of the 1,800 respondents reported receiving formal driver training school instruction prior to becoming a professional driver; the average time as a truck driver was 15 years.[44]

[41]National Transportation Safety Board, op. Cit., footnote 10, p. 7.
[42]"Phil Willis, "Novice Finds Employment Catch-22," True-ker.~ *USA*, vol. 4, No. 30, July 2 1, 1987, p. 29.
[43]National Transportation Safety Board, op. cit., footnote 10, p. 9.
[44]Regular Common Carrier Conference, op. cit., footnote 26, p. 1.

Training Standards

Truck driver training schools are subject to oversight from various licensing and accrediting bodies. Some States, such as Maryland, Pennsylvania, and Indiana, require driver training schools to be licensed, although different agencies are assigned this oversight responsibility. While these authorities often establish a minimum number of course hours, requirements for course content usually are not specified.[45] Some schools have been accredited by the National Association of Trade and Technical Schools or the National Home Study Council. The vast majority of programs, however, have not been accredited by either organization.

DOT issued proposed minimum standards for training tractor-trailer drivers in 1984, in an effort to establish guidelines for truck driver training. The standards call for a minimum 320-hour course lasting 8 weeks, if taken on a full-time basis. Course content included basic truck operation, safe operating practices, advanced operating practices, vehicle maintenance, and nonvehicle activities. The standards also covered instructor qualifications, school facilities, graduation requirements, and student placement. No final action was ever taken on the proposed standards, although the Office of Motor Carriers (formerly the Bureau of Motor Carrier Safety) published a ready-made curriculum, *Model Curriculum for Training Tractor-Trailer Drivers,* in

[45]National Transportation Safety Board, op. cit., footnote 10, p. 11.

Photo credit: Tse-Sung Wu, OTA staff

A **driver receives on-the-road instruction.**

1984. Included in the 2,500-page document are instructions for the school administrator, instructor, and student. **These standards cannot be used for evaluating existing schools until their validity has been tested with actual schools and students, and DOT has not taken steps to do this.**

The Professional Truck Driver Institute of America (PTDIA) was formed by industry in 1986 to certify acceptable training schools. PTDIA has adopted a curriculum based on the Federal model and started certifying driver training programs in mid-1988. PTDIA is funded entirely by industry and has both carrier and public enforcement representatives on its Board of Directors. The organization emphasizes the critical importance of the number of hours of hands-on, behind-the-wheel driving time a student receives.[46] **While PTDIA's activities have been supported by many in the industry, the Commission of Accredited Truck Driving Schools maintains that driving schools should be free to structure their curricula to meet their educational objectives.[47]**

Training Programs

Although relatively few in number, carriers' in-house training activities can be very effective (see box 6-A on UPS, for an example). 1n 1980, a large general commodities motor carrier implemented a training program to instruct all new drivers in the safe handling of the vehicle and cargo and has reported a 14-percent decrease in line-haul accident frequency despite a 38-percent increase in line-haul mileage.[48] In another case, a trucking firm's commitment to training led to the provision of a curriculum, equipment, instructors, and course evaluations as aids to outside training schools.[49] This firm's screening test for prospective drivers has been carefully crafted to identify driving patterns and habits that have the potential to cause accidents.

The insurance industry has also developed training programs to promote safe driving behavior. One insurance company offers a 5-day seminar, open to driver trainers, safety personnel, maintenance supervisors, and to the management of fleet policyholders. It includes both classroom and behind-the-wheel experience. The examination of several fleets' safety records before and after personnel received training showed consistent reductions in accident frequency and loss rate per vehicle.[50]

An alternative approach is developing a truck driver apprenticeship program so that new drivers will receive qualified supervision and develop safe driving habits. In the Netherlands, for instance, prospective new drivers undergo a 2-year apprenticeship.[51] There is currently no organized apprenticeship program for heavy truck drivers in the United States, although the issue has been raised in the past and is again being discussed.

Recurrent training of employees is important not only to keep experienced drivers up-to-date, but to identify bad habits that may have developed over time. For example, research in Europe has shown how little perception even experienced drivers have of their actual speed when they are in a monotonous or repetitive driving situation.[52] On U.S. highways, difficulties with speed perception are acute when a driver leaves the Interstate system and moves onto two-lane roads, where speed limits, access, median control, and signs are quite different.[53]

Keeping drivers physically fit, through physical conditioning, weight control, and aerobic capacity can reduce fatigue and stress. One carrier is installing a physical conditioning program nationwide for its line-haul drivers to assist them in developing physical and mental stamina to cope with long-haul driving.[54]

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[46] Thomas M. Strah, "Truck Driver Training: A Matter of Standards," *Transport Topics,* Jan. 18, 1988, p. 16.

[47] James J. McAlpin, vice president, Administrative Services, USA Training Academy, personal communication, Feb. 4, 1988.

[48] Strah, op. cit., footnote 46, p. 8.

[49] Dannemiller, op. cit., footnote 5, pp. 43-44.

[50] *Southern Motor Cargo Magazine,* "The Driver is the Decision-Maker," May 1984.

[51] National Transportation Safety Board, op. cit., footnote 10, p. 21.

[52] David Lowe, *The Tachograph* (Solihull, England: Fleet Planning Limited, 1982), p. 213.

[53] James Johnston, Owner-Operators Independent Drivers Association of America, in Office of Technology Assessment, op. cit., footnote 5, pp. 116-117.

[54] Dannemiller, op. cit., footnote 5, p. 45.

SHARING THE ROAD WITH THE DRIVING PUBLIC

Heavy vehicle operators often claim that most automobile drivers are unaware of the limitations and space requirements of heavy trucks. The longer, wider trucks now permitted are difficult to see around and require longer distances to pass than current highway designs allow. Heavy truck drivers operating in congested areas try to leave enough distance between their own and other vehicles **for a complete stop. However, automobile drivers often cut sharply in front of trucks, making it difficult to avoid an accident—for which the truck driver may be cited,**

Education programs for automobile drivers could help make them aware of safety issues related to sharing the road with trucks. States such as Tennessee are considering reorganizing their driver licensing programs to include material and questions on truck safety. An information videotape for automobile drivers on sharing the road with trucks is another possibility;[55] it could be shown to people waiting to obtain driver licenses.

Education programs to inform small carriers about better road safety have also been developed. Available through the National Safety Council and ATA, these materials describe how a carrier as small as a 10-person trucking company can implement an effective safety program.

[55]Paul Melander, Tennessee Public Service Commission, personal communication, May 19, 1987.

HOURS OF SERVICE

The hours-of-service rules in effect today are essentially the same as those promulgated in 1937 and 1938 by the Interstate Commerce Commission (ICC).[56] The regulations prohibit carriers from requiring or permitting any driver to drive more than 10 hours at a time after being on duty more than 15 hours. Drivers must have 8 consecutive hours off-duty before driving again. In addition, drivers are prohibited from driving after 60 hours of on-duty time in any 7--day period, or 70 on-duty hours in any period of 8 consecutive days.[57] Drivers are required to keep records of their driving in a logbook that must be available for inspection by enforcement officers at all times. "

Complex and difficult to enforce, the hours-of-**service rule is subject to problems ranging from falsification and abuse of logbooks by drivers to loose interpretations of "on duty" and "off duty" by management. The 15-hour on-duty period can be accounted for during the course of a driver's overall duty day in any number of ways. For example, the** driver's employers may "relieve" him of duty—responsibility for the vehicle—for meals and rest breaks. Tiring and strenuous activities, such as loading and unloading performed by the driver, are not considered part of driving time, although they are considered duty time and usually contribute to fatigue. Furthermore, 8 hours of off-duty time often does not afford drivers adequate time to travel to and from their jobs, eat, bathe, and attend to life's other requirements, as well as to get adequate undisturbed sleep. Finally, the illegal practice of requiring a driver to wait at a terminal in an "off-duty" status for a work assignment contributes to fatigue prior to the start of a driving tour.[55] These factors help explain why many drivers keep double logbooks (one for enforcement officers and one for themselves) or make false entries.

Many drivers are compensated on the basis of how many miles they drive during a pay period. A long-haul driver faces a choice between violating hours-of-service rules and maintaining his income if bad weather, highway conditions, or shipper-related delays prevent him from driving an acceptable number of miles. Drivers risk accidents and deny themselves adequate sleep by accepting loads that require many consecutive hours of driving to reach a final

[56]Trucking is not subject to the Fair Labor Standards Act. Carriers do not have to pay time-and-a-half for a greater than 40-hour work week. This creates an incentive for a carrier to hire the fewest drivers possible and to have them work the longest hours possible in order to maximize profits.

[57]United States Court of Appeals for the District of Columbia Circuit, Professional Drivers Council v. Bureau of Motor Carrier Safety, Petitioners' Brief, No. 81-2283, Mar. 8, 1982.

[58]Ibid., p. 9.

Photo credit: Michael Hines, OTA staff

Federal regulations require drivers to record their hours of service.

destination on time. Nonetheless, drivers sometimes boast of their long-distance driving accomplishments and stoically shrug-off unrealistic shipper deadlines.[59]

ICC, and subsequently DOT, have recognized that the hours-of-service rules are subject to abuse. In 1972, the Bureau of Motor Carrier Safety (BMCS) in DOT initiated a comprehensive study of the relationship between dangerous levels of fatigue among truck drivers and the current hours-of-service regulations.[60] The report compiled and analyzed scientific and medical data reflecting driver performance and physiological responses collected during 195 truck and bus runs. A total of 1,550 hours of continuous data was obtained and analyzed on 62,000 miles of highway truck travel in all parts of the country, and in all weather and traffic conditions. The study concluded:

> . . . driver performance deteriorates, driver alertness . . , diminishes, rest breaks become less effective, and accident probability increases, all within the current 10-hour daily limitation on driving time. It [the regulation] is further at odds with a good deal of anecdotal evidence from the drivers to the effect that they do suffer from considerable fatigue but are

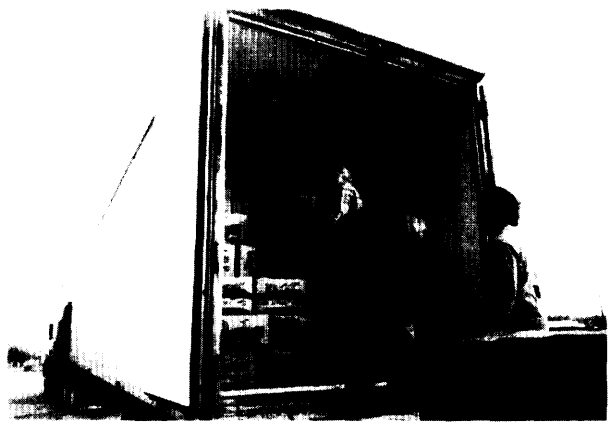


Photo credit: Land Line

On duty activities such as loading and unloading, in addition to driving, contribute to driver fatigue.

[59] An OTA staff member heard one operator in Pennsylvania at 8:00 a.m. admit to having to be in Burbank, California at 11:00 a.m. just 2 days later.

[60] In 1985, the Bureau of Motor Carrier Safety was reorganized and renamed the Office of Motor Carriers.

unwilling to admit it because of the feared economic consequences.[61]

This study focused on scheduled relay operations of large common carriers whose drivers were able to plan their rest,[62] and no formal regulatory action was taken. BMCS acknowledged that further research was needed to provide data for revising hours-of-service rules, especially on drivers whose assignments were irregular in frequency, duration, and starting times, and who often could not predict when they would be driving.

The second phase of BMCS's fatigue study, issued in 1978, found that relay drivers operating irregular schedules suffered greater fatigue, physiological stress, and performance degradation than drivers working similar hours on a regular schedule. Fatigue effects were evident after about 8 hours of relay truck driving on a regular schedule and considerably earlier when the schedule was irregular. Cargo loading increased the severity of fatigue associated with irregular working schedules.[63] The reported findings were considered conservative, since the drivers in the study were allowed 8 hours of sleep each day.

A separate, concurrent study of accident data found that the length of driving time by itself was not related to frequency or severity of truck accidents. However, the combination of driving and nondriving time could be related to driver fatigue and play a role in accident occurrence.[64] Following the results of these studies, BMCS subsequently issued a Notice of Proposed Rulemaking and conducted public hearings in several cities around the country. By the end of 1978, BMCS had accumulated what it considered to be sufficient information to justify amending the hours-of-service regulations.[65] Table 6-3 provides a summary of hours-of-service regulation options that BMCS considered.

In 1981, however, the agency terminated the rulemaking action and closed the docket, citing the absence of a direct relationship between the hours-of-service rules and accidents. Also, in 1981 BMCS commissioned an economic study of the cost of modifying the hours-of-service rules to conform with Office of Management and Budget and DOT policy requirements. The projected costs of each of the government's three major options were considered to be significantly greater than the projected benefits.[66]

[61] William Harris et al., Human Factors Research, Inc., *A Study of the Relationships Among Fatigue, Hours of Service, and Safety of Operations of Truck and Bus Drivers*, Report No. BMCS-RD-7 1-2 (Washington, DC: U.S. Department of Transportation, Federal Highway Administration, Bureau of Motor Carrier Safety, November 1972), p. xi.

[62] Robert A. Kaye, Director of the Bureau of Motor Carrier Safety, memo to Arthur L. Fox, II, Esq., Aug. 21, 1973.

[63] Robert R. Mackie and James C. Miller, Human Factors Research, Inc., *Effects of Hours of Service, Regularity of Schedules, and Cargo Loading on Truck and Bus Driver Fatigue,* Report No. DOT HS-803 799 (Washington, DC: U.S. Department of Transportation, National Highway Traffic Safety Administration, October 1978).

[64] Safety Management Institute, *Analysis of Accident Data and Hours of Service of Interstate Commercial Motor Vehicle Drivers*, prepared for the Bureau of Motor Carrier Safety (Washington, DC: Aug. 11, 1978).

[65] United States Court of Appeals, op. cit., footnote 57, p. 18.

[66] Booz, Allen & Hamilton, Inc., *Assessment of rhe Impacts of Proposed Hours of Service Revisions,* prepared for the Bureau of Motor Carrier Safety (Washington, DC: June 24, 1981).

FATIGUE AND SLEEP NEEDS

Medically-related sleep disorders and occupationally-induced sleep disturbances seriously impair driving ability. Scientific literature makes clear that human performance is best at moderate levels of arousal. At low levels, the brain loses the capacity to make quick and informed decisions; at high levels, actions may be frequent, but ill-directed.[67] Fatigue and sleepiness are associated with low levels of arousal. Normal fatigue can be exacerbated by three categories of stress factors: 1) physical environment such as temperature and vibration; 2) physiological factors such as poor or inadequate sleep, *drugs* and alcohol, or irregular eating habits; and 3) psychological factors such as anger, fear, and frustration.[68] A distinction is sometimes made for drivers between single-trip fatigue, where an opportunity for recovery may exist; cumulative fatigue, in which recovery time between trips is not adequate; and chronic fatigue, which usually requires medical assistance. The behavorial symptoms of all three types

[67] Allnutt, op. cit., footnote 2, p.13.

[68] Ibid., p. 15.

Table 6-3.—Current and Proposed Hours-of-Service Regulations

Section	Current regulations	Option I	Option II	Option III
Driving time	10 hours	8 hours	12 hours	10 hours
On-duty time	15 hours	12 hours	12 hours	15 hours
Cumulative on-duty time	70 hours in 8-day period 60 hours in 7-day period	70 hours in 8-day period		70 hours in 8-day period 60 hours in 7-day period
Off-duty periods	8 hours 10 hours at home terminal 24 consecutive hours after driving during 6 days	**8 hours at foreign terminal** **12 hours** at home terminal 24 consecutive hours per 7-day period, or 48 consecutive hours per 14-day period	8 hours at foreign terminal	8 hours
Meal period	None required	30 minutes after 7 or more hours on duty (logged as on duty)	**30 minutes after 7** or more hours on duty (logged as on duty)	None required
Driving relief period	None required	30 minutes after 4 hours (logged as on duty), may include meal period	30 minutes after 4 hours (logged as on duty), may include meal period	None required
Intermittent off duty	Not prohibited	Prohibited	Not prohibited	Not prohibited
Duty tour limit	No specific limit	15 consecutive hours	12 consecutive hours	No specific limit
Sleeper berth	2 periods totaling 8 hours, neither less than 2 hours	2 periods totaling 8 hours, neither less than 2 hours	Any 8 consecutive hours of duty may include sleeper berth time and off duty combined if consecutive	2 periods totaling 8 hours, neither less than 2 hours
Time-of-day restrictions	None	None	None	Driving between midnight and 6 a.m. prohibited

SOURCE: Office of Motor Carriers, 1988.

of fatigue are similar, however.[69] Sound, adequate sleep is the best way to relieve fatigue, which is an independent variable affecting behavior and performance.

Off-duty time, as specified in the regulations, often does not translate into sleep or rest time, as it was intended to do, partly because of the way the body functions biologically. Sleep researchers have shown that the body typically functions according to a circadian, or 24-hour, cycle that includes regular, defined periods of rest. Thus, when a driver starts his off-duty time, he may not be biologically ready to rest. As an example, a driver who begins a driving day at 6:00 a.m. must stop to rest at 4:00 p.m., according to the regulations. However, unless this is his accustomed time for sleep, his circadian cycle is not ready for him to begin prolonged rest. The driver is likely to take a nap eventually, but can begin driving again at midnight, just when the body's normal circadian cycle prepares him for sleep.[70] As a result, his alertness level and ability to operate a vehicle will be severely impaired.

The type of rest can affect driver performance as well. One recent study of truck drivers found that sleep disruption associated with sleeper berth use causes fatigue and deterioration of truck driver performance. In fact, the accumulation of 8 hours rest split between two sleeper berth shifts increased the risk of death by a factor of three for truck drivers involved in accidents, according to the research results.[71] Moreover, research in Europe shows that accident involvement rates for truck drivers increase dramatically as work shift duration exceeds 8 hours (see figure 6-3).[72]

Research also shows that no amount of mental or physical conditioning can prepare people to operate at normal levels if deprived of sleep. Reaction times double or triple, and the brain lapses into sleep for fractions of seconds at a time, especially during monotonous circumstances, such as driving. Such factors may explain the disproportionate share of

[69]Ibid., p. 18.

[70]David Dinges, University of Pennsylvania, in Office of Technology Assessment, op. cit., footnote 5, pp. 73, 75, 127.

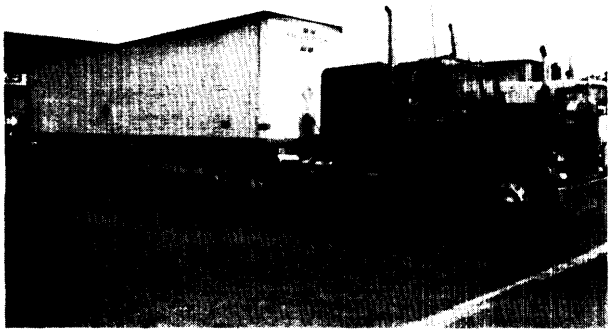


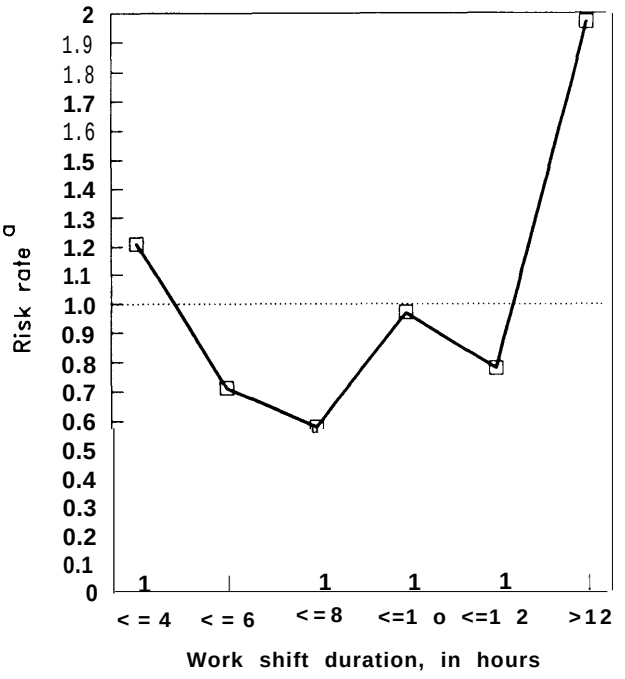
Photo credit: Karen Mathiasen, OTA staff

Drivers who sleep in sleeper berths do not receive adequate rest, according to recent research.

[71]Robin P. Hertz, "Sleeper Berth Use as a Risk Factor for Tractor-Trailer Driver Fatality," paper presented to the American Association for Automotive Medicine, New Orleans, LA, September 1987, pp. 9-10.

[72]Patrick Hamelin, "Truck Driver Involvement in Traffic Accidents as Related to their Shiftworks and Professional Features," *Symposium on the Role of Heavy Freight Vehicles in Traffic Accidents*, vol. 2 (Ottawa, Canada: Organisation for Economic Cooperation and Development, April 1987), pp. 3-107.

Figure 6.3.—Truck Accident Risk Compared With Duration of Truck Work Shift



aA risk rate greater than 1.0 means that on average, more accidents occur at those times in a given work shift than would be expected on the basis of the number of truck trips.

SOURCE: Office of Technology Assessment, adapted from Patrick Hamelin, '(Truck Driver's Involvement in Traffic Accidents as Related to Their Shiftworks and Professional Features," Symposium *on the Role of Heavy Freight Vehicles in Traffic Accidents* (Ottawa, Canada: Organisation for Economic Cooperation and Development, April 1987), vol. 2, pp 3-107.

accidents that occur 1 or 2 hours into a driving shift,[73] and the high level of fatal accidents in the early morning hours between 5:00 and 7:00 a.m. According to sleep researchers, these are times when a person is particularly vulnerable to an accident-causing situation due to lowered alertness. Experts have found that an additional period of decreased alertness also occurs in the mid-afternoon.[74] Drugs and alcohol also affect a sleepy person much more strongly. [75]

Overweight, middle-aged males, a description fitting many truck drivers, are primary targets for a sleep disorder known as sleep apnea. A person suffering from sleep apnea rarely knows he or she suffers from the disorder, which is characterized by abnormal breathing at night and results in excessive daytime sleeping.[76] While some companies can schedule drivers so that their on-duty and rest hours occur at regular 24-hour intervals, others find it difficult. However, driver and management awareness of the reality of the effects of sleep deprivation and the vulnerability to accidents is a first step toward addressing the problem. Management sensitivity to the fact that some drivers may be less alert during driving tours due to a sleep disorder is also important.

The development of portable performance devices that detect, in a quick, reliable, and noninvasive manner, whether a person is reacting adequately to the road is a realistic long-term goal.[77] Such alertness devices, however, can create an environment of false security—an operator awakened by such a device may conclude that he can continue driving since he is awake. Alternatively, the driver could feel tired but decide to continue" driving because he assumed that the alertness device would awaken him if he did fall asleep. The driver remains ultimately responsible for driving safely, for not substituting these devices for sleep, and for adhering to hours-of-service regulations.

[73] Hertz, op. cit., footnote 71, p. 76.
[74] *Technology Review*, "Mathematics of Sleep," February-March 1987, p. 13.
[75] David Dinges, University of Pennsylvania, testimony before the Senate Committee on Appropriations, Subcommittee on Transportation, May 14, 1987.
[76] David Dinges, University of Pennsylvania, personal communication, May 19, 1985.
[77] Ibid.

TECHNOLOGIES TO ADDRESS HUMAN PERFORMANCE ISSUES

Carriers utilize numerous technologies to address management concerns about driver performance. For example, driving at high speed and the frequency and severity of accidents are strongly correlated (see chapter 4). Many carriers have chosen to install road-speed governors to limit the speed at which their tractors operate. These devices prevent the engine from generating more than the specified revolutions per minute, thus controlling the top speed of the vehicle. If maintained in good working order, governors can keep speed close to the legal limit and improve fuel economy as well.

Some States, such as Virginia, have outlawed the use of radar detectors in efforts to curtail speeding. Since the sole function of a radar detector is to recognize when radar is measuring the vehicle's speed, the prevalence of these devices in trucks indicates the potential for abusing speed limits. One recent study found that radar detectors encourage speeding, with the vehicles traveling fastest being most likely to be equipped with the devices. Moreover, of all vehicles on the road, tractor-trailers are the most likely to be equipped with radar detectors.[78] In another survey, 69 percent of owner-operators responding acknowledged that their vehicles were equipped with radar detectors.[79] Further study of driver behavior in radar detector-equipped vehicles is underway at the Texas Transportation Institute, although results are not yet available.[80] A separate survey of truckers in Florida found that 79 percent use radar detectors.[81]

The use of detectable radar by enforcement officers countered by the use of radar detectors and radar jamming devices by drivers reflect the conflicts between a highly competitive market and enforcing safety standards. While some segments of the car-

[78] *IIHS Status Report*, "Radar Detectors Spur Speeding," vol. 22, No. 3, Mar. 14, 1987.
"Owner-Operators Independent Drivers Association of America, "Survey," unpublished manuscript, Mar. 23, 1988.
[80] Dave Seiler, National Highway Traffic Safety Administration, personal communication, Apr. 11, *1988.*
[81] Regular Common Carrier Conference, op. cit., footnote 26, p. 2

rier industry oppose legal sanctions against the devices, a joint petition to DOT was filed in spring 1988 by the American Automobile Association, ATA, the Insurance Institute for Highway Safety, and the National Safety Council, asking that they be prohibited.

On-Board Recording Devices

Safety advocates have proposed using on-board recording devices to monitor compliance with hours-of-service rules. Units are currently available that can track distance traveled, driving time, breaks, daily rest periods, and speed limit compliance in addition to equipment-related information. These devices are discussed at length in chapter 5.

Photo credit: Rockwell /nternational Corp.

This on-board computer automatically records and stores the driver's hours of service.

Photo credit: Rockwell International Corp

Computers that store driving records and hours-of-service information can be an efficient alternative to paperwork.

CONCLUSIONS AND POLICY OPTIONS

Improving human performance in an industry that must meet demanding time schedules to prosper is a difficult task. However, since human error is the largest single cause of motor carrier accidents, OTA concludes that an aggressive Federal pro. gram to address human factors issues is a top priority.

Legislation passed in 1986 requiring a Commercial Driver's License (CDL) is a major step in establishing uniform truck driver licensing standards and practices. OTA concludes that for public safety, no exemptions to the requirement for a CDL are warranted. Exemptions of any kind would weaken the effectiveness of the legislation. Congress will wish to monitor closely DOT's decisions as the CDL program is implemented. For example, abundant evidence exists that truck driver performance is impaired by BAC levels below 0.10 percent and that alcohol use increases both the likelihood and severity of accidents. Congress may wish to ensure that DOT sets acceptable BAC levels for truck drivers at 0.04 percent (or lower), corresponding to the levels for airline crews and railroad engineers.

Further, OTA concludes that drug abuse by truck drivers is a significant safety factor that deserves substantial study to prepare for regulation. The results of the current NTSB study will provide valuable information on levels of drug use and their contribution to driver impairment. However, more study will be necessary to determine the appropriate regulatory standards. A requirement for drug and alcohol screening for driver applicants, as part of periodic DOT-required physical examina-

tions, and for probable suspicion or cause, deserves consideration. Furthermore, a DOT pilot demonstration program with one or more States for random drug testing could provide valuable information on the role of such testing in accident reduction and the acceptability of such a program on a national basis. Congress may wish to encourage DOT to act on these options. Since a record of previous violations is characteristic of many truck drivers involved in serious accidents, Congress may wish to monitor DOT's decisions about violations committed during part-time employment or off-duty driving.

The contribution that careful, appropriate training can make to accident reduction has been amply documented by industry. **OTA concludes that training is an area neglected by DOT and that national guidelines for driver training are needed. (See chapter 4 for policy options that address this issue.)**

Considerable public and private effort will be required to make any new safety standards effective. Carrier management commitment to safety and to implementing new standards play pivotal roles. A cooperative government-private sector research and education program is one way to address management issues such as driver hiring, screening, training programs, and scheduling revisions to help accommodate circadian rhythm.

The hours-of-service regulations, do not adequately account for the effects of operating on the Interstate highway system, new vehicle technologies, and advances in understanding of fatigue and sleep needs. OTA finds compelling reasons for DOT to reexamine the hours-of-service rules and, if warranted, to develop revised standards based on current research results and today's around-the-clock operating environment. A carefully phased program to address the issue is essential. Cooperative government-industry studies including independent drivers, private carriers, and large and small for-hire carriers to explore feasible scheduling, training, and education programs are important initial steps. Congress may wish to encourage more DOT research on this issue, to provide funds for the research, and to meet specified deadlines for revised standards.

OTA concludes that Federal programs are needed to help management and drivers understand when drivers are most vulnerable to accidents and how alterations to scheduling and other procedures could reduce driver vulnerability. Moreover, a research program to develop simple, effective, and inexpensive techniques to screen drivers who may have a sleep disorder could help identify the high-risk driver.

OTA **finds that the use of radar detectors by motor carrier and automobile drivers alike promotes speeding and thus increases the likelihood of an accident. Because high speeds are closely tied to accident severity, Congress may wish to consider taking decisive steps at the Federal level to prohibit these devices.**

Finally, education programs directed at motor carrier and automobile drivers could enhance awareness of safety issues related to sharing the roads. These programs should focus on the handling and stability characteristics of trucks, the need to maintain adequate distance between vehicles, the longer distances required for a heavy truck to stop, and the severe damage that can result from a collision between cars and trucks. Congress may wish to require the National Highway Traffic Safety Administration and FHWA to play mutually supportive roles in developing a model program for States to ensure that these messages reach a broad population by being incorporated into the driver license and renewal process.