

**COMMERCIAL VEHICLE ACCIDENTS:
THE DATA GATHERING EXPERIENCE**

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ABSTRACT

Establishing the factors which cause accidents is a difficult and time consuming process requiring expertise in diverse disciplines. An accident, especially if it involves a commercial vehicle, is often the result of more than one factor. The cause however, may often be attributed to only one major item on the Motor Vehicle Accident Report form used by law enforcement agencies to record the occurrence of a motor vehicle accident.

The information recorded on the Motor Vehicle Accident Report forms is the most frequently accessed source of mass accident data. Information from this source is analyzed by safety bureaus, transportation authorities, regulatory bodies, and other organizations whose aim it is to reduce the number of traffic accidents and to promote safe and proper use of the highway system. Although limited in scope, the Motor Vehicle Accident Report is a very useful data source but its content must be used with discetion.

This report presents observations made during and following an on-the-scene commercial vehicle accident survey conducted at the professional reconstruction level by the Ontario Ministry of Transportation. The intent of the survey was to identify accident causation factors, merge the information with that from the mass data bank, and identify areas of concern. This paper includes an overview of methodology used, identifies some shortcomings, and presents some investigation procedures learned through on-the-job experience.

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INTRODUCTION

Traffic accidents are investigated for many different reasons. Enforcement agencies do so to establish fault according to municipal, provincial or federal ordinances. Private agencies and law firms do so on behalf of their clients for purposes of litigation and compensation. Educational institutions and government authorities do so to establish mass data used to establish trends, identify areas of research, and formulate policy.

In Ontario the most widely used source of accident data is the Motor Vehicle Accident Report used by law enforcement agencies to document a specific reportable motor vehicle accident. Its primary function is not to provide research data. However the content and scope of the data are adequate to meet the needs of most users. Other established sources of accident and vehicle-related mass data offer a greater level of detail:

TRIAD: Traffic Accident Information Data System,
Road Safety Directorate, Transport Canada,
FARS: Fatal Accident Reporting System, NHTSA
BMCS: Bureau of Motor Carrier Safety Accident Reports,
NASS: National Accident Sampling System,
TIU: Truck Inventory and Use Survey.

Provincial, State, and Federal transportation authorities, university groups, and insurance companies are other sources of accident information.

Accidents involving commercial vehicles are unlike accidents involving automobiles in many respects, apart from a difference in the severity of damage. The complexity of commercial vehicle design and operation makes accident investigation much more difficult. If the commercial vehicle is articulated the difficulty is that much greater. A further difficulty is that the typical Motor Vehicle Accident Report cannot accommodate the data necessary to properly describe a commercial vehicle accident. The Motor Vehicle Accident Report for a commercial vehicle accident may therefore be incomplete, inaccurate, or both. If the intent of an accident study is to identify accident causation factors, be it those associated with automobiles or commercial vehicles, use of an on-the-scene, technical accident investigation program should be considered.

OVERVIEW

Accident investigation is a technical activity undertaken to obtain and record data. In most cases data are collected with a specific use in mind. It is this use which dictates the type of data to be collected. Once assembled, the data are refined, opinions formed, and conclusions drawn.

The process of a technical investigation of a motor vehicle accident can be divided into four distinct phases. Each level includes the actions of all preceding levels of investigation.

1. Accident Reporting:

The Motor Vehicle Accident Report is used at this level. The basic facts concerning the accident are recorded.

2. On-The-Scene Accident Investigation:

Additional data are gathered to be used to determine how, and sometimes why, the accident occurred. This level usually determines if there was a violation of the law.

3. Technical Accident Investigation:

Further information not normally obtained at the accident scene is gathered and packaged. Data analysis at this level is often used to identify areas requiring study.

4. Professional Reconstruction:

The data are interpreted to determine how and why the accident occurred. The conclusions drawn are usually for purposes of litigation and may lead to full-scale research projects.

A motor vehicle accident can also be broken down into the following components, each requiring specific expertise for investigation and analysis: the collision, the vehicle, the injury, driver action/reaction, and the environment [1]. If accident reconstruction is the intent then all of these components must be addressed. Certain data must be collected regardless of the type of accident. Common sense and the end use will dictate what additional data are required, and the manner in which the data should be organized.

ACCIDENT INVESTIGATION OBSERVATIONS

FIRST:

DETERMINE "HOW" THE ACCIDENT OCCURRED,

THEN:

DETERMINE "WHY" IT HAPPENED!

Experience gained during a commercial articulated vehicle accident survey conducted by the Ontario Ministry of Transportation, revealed that preparation is the key to a successful program [2]. The survey, conducted in two phases, used experience gained during the first phase to refine procedures for the second phase.

The Method

Establish The Intent of the Study. The intent will dictate the format of the record, the type of data, and the level of technical expertise required by personnel gathering the data [3]. It will also structure critical thinking during the study.

Use Personnel Who Have The Required Expertise. The technicians who collect accident data should be knowledgeable in their sphere of data gathering. This is very important when investigating accidents involving commercial vehicles. Commercial vehicles, particularly those which are articulated, are complex. The terminology and skills associated with the operation of these vehicles are quite different from those associated with passenger cars.

If the intent of the survey is to gather data on mechanical defects and to establish the road-worthiness of the vehicle the accident investigation team should include either a certified mechanic or a vehicle technician experienced in commercial vehicle maintenance and operation. This person should also be licensed to operate a commercial articulated vehicle so the team can conduct road tests.

Any personnel investigating accidents are likely to be called as witnesses in subsequent legal actions. The competency of the technicians establishes their credibility as expert witnesses in a court of law.

To enhance the expertise of the Ministry of Transportation accident investigation team, a member familiar with commercial articulated vehicle operation enrolled in the Technical Accident Investigation course offered by the Traffic Institute at Northwestern University, Evanston Illinois [4]. This knowledge was then passed-on to other members of the team by means of informal, in-house instruction.

Establish Good Data Recording Techniques. It is important to develop proper forms for recording accident data. A good form will have components specific to each aspect of the accident. The form should be structured to lead the technician through each aspect of the accident, beginning with the "must have" data, leading into the more general data, and ending with observations. Instruction or reminders should be included on the form where necessary.

Data should be recorded using pen or other non-erasable medium. This will prevent possible alteration and make the data more readily accepted as evidence by the court. Tape recorders tend to freeze up in winter; their batteries fail unexpectedly; and the dirty environment at the accident scene can damage their mechanisms. Recorded statements can be misunderstood when transcribed by someone other than the dictating technician.

GET ALL OF THE DATA DURING THE FIRST VISIT TO THE ACCIDENT SCENE. It is nearly impossible to obtain additional data by returning to the accident scene at a later date.

There are some instances where familiarity with different types of accidents, particularly commercial vehicle accidents, will provide the technician with a different perspective from that of the police officer. In this case it is wise to follow both hunches, and record all the data required by both parties. This assures that the cause of the accident can be established.

There is a tendency to record less data for a minor accident than for a major accident. To maintain the quality of the mass data and eliminate any possible bias, accident data input must be consistent regardless of accident severity. Should a secondary source of accident data be used in the study, the terminology and definitions should be consistent with those used by the technician gathering the primary data. This will make data comparison easier.

Neatness is essential! Once recorded, data must not be altered. Traffic accident data are often used in a court of law. If altered, the data can be deemed suspect. This will reflect badly on the investigator and the overall accident investigation, and may ultimately affect the outcome of the case. Tape-recorded evidence is often rejected for similar reasons.

Colour photographs of the accident scene are a definite asset to an accident investigation. Ideally the camera should be equipped with a "data back" to record the date and accident identification number on each photograph. Photographs will sometimes capture data that have been overlooked, ensure proper vehicle identification and position and later, refresh the memory of the investigating technician. Good photographs help immeasurably to inform a court, and can reinforce the testimony of the expert witness should accident data be subpoenaed.

Assemble A Good Work Kit. The technician gathering accident information must have the proper tools with which to collect accident data. The kit should include a camera complete with a data back and an electronic flash; a certified measuring wheel, surveyor's chain, tread depth gauge, and tire pressure gauge; coveralls, bump hats, and other personal protection; and miscellaneous items necessary to record the required data.

Establish A Workable Accident Notification Method And Investigation Area. Prompt notification of the occurrence of an accident is a prerequisite for a workable accident investigation program. Establish a reasonable accident investigation team response time. That response time will define the geographical investigation area. Likely weather conditions, traffic density, and road shoulder access must also be considered when establishing the investigation area since they all influence response time. The time factors of a typical accident on the 401 bypass in Toronto [2] are:

- detection time, 9 minutes,
- police response time, 7-8 minutes,
- tow truck response time, 15 minutes,
- accident investigation time, at the scene,
30-40 minutes.

The geographical area should be conservatively defined. This will ensure that the investigation team can arrive at the accident scene within the specified time frame, thus maintaining the investigation team's credibility with the police.

The police officer at an accident scene is primarily dealing with casualties, and reopening the roadway as quickly as possible. It may thus be necessary to limit investigations only to major accidents which close the roadway for an hour or more. The Ministry relied on the police officer at the scene to rate accident severity, the length of time the road would be closed, and the accident investigation team was notified accordingly. Since accidents involving commercial vehicles usually close the roadway for a considerable length of time, very few accidents were not investigated.

The team was notified of an accident by means of a 24-hour voice page system which provided the phone number of the police detachment handling the accident. The detachment then provided details about accident type, location, and severity. On the basis of this information the team member determined whether or not the accident would be investigated.

Attempts to limit the study to an 8-hour working day proved to be futile. Although the greatest number of commercial vehicle accidents occur between 7:00 a.m. and 6:00 p.m., the period of maximum traffic density, there are sufficient accidents of a serious nature occurring outside that time frame however, to warrant a 24-hour availability of the investigation team.

Identify The Accident Investigation Team. The vehicle used by the team members should be equipped with either a flashing or revolving roof-mounted amber beacon. The use of a red beacon on vehicles other than emergency and police vehicles and those identified in the Highway Traffic Act is usually prohibited by law [5]. Marking the vehicle with a decal to identify it as belonging to the accident investigation team is also useful.

Team members should be provided with business cards or other identification. This will direct all inquiries about the efforts of the investigation team to the proper information centre.

Vehicle Defects

In many accidents, there is no single cause but rather a series of contributing factors involving mechanical defects or failures [6]. Collecting information on commercial vehicle defects and proving the occurrence of mechanical failure is in most cases a difficult task.

Many commercial vehicle drivers involved in accidents report air brake failure as the cause. It is therefore important to conduct a proper investigation of the air brake system. Some inspections can be done at the scene, others must be done later. All of these inspections present difficulties to the investigator.

Pushrod stroke is a good indicator of air brake system operation and should be checked if poor braking was cited as the being the cause of the accident. Excessive stroke promotes inefficient braking. The brake can be operated manually by pulling on the slack adjuster and the stroke measured if the emergency brakes have not been applied. If air is available in the system, stroke can be measured by applying the brakes in a normal fashion.

Examining the undercarriage of a truck at the accident scene in unpleasant weather is dirty work. The temptation is to remove the vehicle to a clean, dry, comfortable garage. In some cases this will result in a destruction of evidence. In winter, water accumulations in improperly maintained air reservoirs can cause system failure if the water freezes, blocking valves and air lines. A warm garage will literally melt away evidence of ice contamination as being a cause. Certain types of semi trailers with low undercarriages (floats, livestock carriers, and low-beds) are especially prone to this type of air brake system failure because their air reservoirs are difficult to access for preventive maintenance.

Air brake system inspection can be dangerous, so proper methods should be established. Spring brake pots, if fractured during an accident, can allow the compressed spring to fly free of the brake chamber mechanism. A technician, struck by this spring, could be severely injured, or even killed.

The proper identification of a tire failure requires some formal training. The Ministry survey revealed that a commercial vehicle accident judged by the police officer to be the result of tire failure on the steering axle was in fact often precipitated by some other factor. The tire failure was usually due to impact with some obstacle during the course of the accident. Statements by the driver concerning loss of control due to tire failure tend to be self-serving.

Most police officers are not familiar with out-of-service criteria for either automobiles or commercial vehicles. Even a knowledgeable officer, if lacking the necessary tools, cannot adequately inspect the vehicle. Vehicle defects which might have a bearing on the accident mechanism can therefore go undetected or unreported.

Human Factors

The truck driver's role in an accident is difficult to assess. There is a reluctance to discuss the accident with the investigator, particularly if the driver feels he may be at fault. Even if the driver is not at fault, the statements are still usually self-serving. Promising confidentiality of information may make interviewing drivers easier but it may be difficult for the agency conducting the survey to preserve this confidentiality during subsequent prosecution and litigation.

Other driver-related data are also difficult to obtain. The police files will only show the number of accidents a driver has had, whether or not he was at fault, and whether or not alcohol or drugs were involved. Driving experience, type of training, and physical and psychological condition are not on record and are difficult to establish, especially if the driver is from out of province or state.

When investigating commercial vehicle accidents it is worth noting if the driver is a broker (self-employed) or is employed by the company operating the truck. The basis for driver payment --by the mile, by the hour, or by the trip-- can influence driver actions and is worthwhile exploring. Self-employment can have a bearing on the mechanical fitness of the vehicle. If times are hard truck maintenance is usually first to suffer.

After The Fact

The involvement of the accident investigation team does not end with the completion of the accident survey. These teams are usually associated with publicly-funded agencies and as such are required to place the accident data in the public domain. These data and the technicians and analysts who have collected and used them to form opinions, can be and often are subpoenaed by police and law firms. Ontario Ministry of Transportation staff who have been accepted as expert witnesses by the court have been subpoenaed as late as three years after the accident, and require time away from their new duties to review accident files and to prepare for the court appearance. To this end a proper and readily accessible motor vehicle accident investigation data filing system must be maintained.

The presentation of information and opinions in a court of law can be frustrating to the expert witness. Attorneys and police officers who interrogate the expert witness in order to enter accident information as evidence are for the most part unfamiliar with commercial vehicle operation and terminology. Magistrates, who rely on the Highway Traffic Act to establish fault, are often reluctant to accept accident reconstruction and opinions from technical experts.

Furthermore, all the careful preparation, research, and testimony can be dismissed if counsel makes an error when entering evidence, or if the court is intimidated by the task of making judgements based on highly technical evidence falling outside the Highway Traffic Act. The likelihood of having technical evidence dismissed or discounted can be diminished if the expert witness is given time to confer with counsel and educate them in the significance of accident investigation data.

THE MOTOR VEHICLE ACCIDENT REPORT

The most widely used means by which motor vehicle accident data are recorded is the Motor Vehicle Accident Report form used by law enforcement agencies. The format may differ from agency to agency but the data gathered and methodology used is similar in most cases. The Ontario Ministry of Transportation's Motor Vehicle Accident Report manual [7] offers the following definition and use summary.

Summary.

The Motor Vehicle Accident Report, Form SR-LD-401 serves a variety of users including:

- police officers who prepare the report,
- traffic engineers who analyze accidents and trends for highway design and maintenance,
- involved persons, their lawyers and insurance companies.

Definition Of An Accident.

"For the purposes of accident reporting, an accident is the unintended contact resulting from the motion of a motor vehicle or streetcar or its load that produces property damage, injury, or death."

Reportable Accidents.

The Motor Vehicle Accident Report form is completed and forwarded to the Registrar of Motor Vehicles (MTO) for accidents which:

- result in a fatality within 30 days,
- result in injury to one or more persons,
- exceed \$700 in total damage,
- involve motorized snow vehicles and total damage exceeds \$400.

Distribution of Copies.

The general distribution of each of the five copies of the Motor Vehicle Accident Report is as follows:

- Copy 1 - Police Force or Municipality
- Copy 2 - MTO: Collision and Licensing Records
- Copy 3 - MTO: Claims Section
- Copy 4, 5 - Drivers involved in the accident

The success of the Motor Vehicle Accident Report relies on the competence of the police officer when making observations and forming opinions [8]. The format requires square filling; one has space for an accident diagram and for recording the names and statements of witnesses and those involved in the accident. The Motor Vehicle Accident Report used by the Ontario Provincial Police (OPP), is only one page in length to facilitate use in the confines of a police car, and to keep the burden of paperwork associated with law enforcement to a minimum. Meeting the data requirements of both police officers and traffic engineers, its content is a compromise.

The average police officer receives little formal training in motor vehicle accident investigation techniques, and only a small part of this would be for accidents involving large commercial vehicles. Even the more experienced police officers are often intimidated by an accident involving a large commercial vehicle. They may only record what they believe is their responsibility to observe. In general police officers tend to depend on others to tell them how the accident happened.

The opinion of a police officer is often influenced by statements gathered at the accident scene. The drivers involved in the accident tend to report the most plausible, least incriminating circumstance [9]. Similarly statements made by witnesses are open to interpretation. The statement, "I heard the bang and saw the whole thing", is typical and should be considered with caution.

On most Motor Vehicle Accident Reports, the officer concludes that apparent driver action is the probable cause of the accident. This fulfills the obligation of the police to establish cause relating to the Highway Traffic Act. The driver action most often used is "speed too fast" for prevailing conditions. This is estimated to have only a 50% accuracy when applied to commercial vehicle accidents. Estimates obtained from witnesses of commercial vehicle speed prior to an accident are often misleading. The size associated with these vehicles and the wind buffeting they produce tend to colour speed estimates. Experience has shown that accurate estimates of commercial vehicle speed can only be obtained from tachometers or other on-board recording devices. The police officer and technician should be aware that tachometers do exist and are often hidden, and that the tachometer card or tape should be impounded for use as evidence. It can prove or disprove that speed was a factor in the accident.

The bottom of the report carries this instruction: "All Boxes Must Be Completed By Officers Submitting Report". The filling of all squares no doubt makes data entry into the computer easier but can force the police officer, if unsure, to use a "best guess" approach and result in data of questionable accuracy.

The filling of all the squares on a motor vehicle accident report means only that data has been recorded and the accident reported. It does not mean that the accident has been investigated. Conducting a follow-up investigation to a commercial vehicle accident is time consuming and expensive. Police generally will undertake one only when the severity of an accident forces them to do so.

Motor Vehicle Accident Report Data

As part of the Commercial Vehicle Accident Survey the Ministry reviewed 6420 Motor Vehicle Accident Report forms. Of these, 474 involved commercial articulated vehicles [2]. The experienced technician reviewing these reports, freed from the obligation having to establish fault under the Highway Traffic Act, sometimes formed opinions that differed from those of the investigating police officer. These differences, although few in number, influenced the results when the relatively small sample (474) of accidents was analyzed.

Computer retrieval of mass data from motor vehicle accident reports does not account for anomalies. Take the case where an unlicensed tank truck used to refuel aircraft, and driven by a person under the influence of drugs, comes into collision with several automobiles, the collisions occurring over several kilometers of public highway. The information from this scenario could be included in the data file as a drug-related motor vehicle accident involving an unlicensed tank truck and several automobiles. Depending on whether or not all collisions were reported on the same accident form (which would be unlikely if the individual collisions were some distance apart and the accident reporting was done by more than one police officer) the data could be entered as several accidents involving said truck and driver. This scenario raises the question whether the data from the accident(s) should be included in the general mass data bank since they could, for example, unduly affect the results of study investigating commercial tank truck accidents.

The report of the Ontario Commission on Truck Safety concluded in part that "...in Ontario the present methods of collecting and analyzing traffic accident information are better than in most Canadian provinces and American states, but they are still inadequate for the identification of the specific causes of accidents involving large trucks", and that "...present methods tend to concentrate on information needed for legal purposes and tend to deal with technical matters to the neglect of human and medical factors such as driver training, experience, and condition" [10]. Most motor vehicle accident data involving commercial vehicles lack detail on truck characteristics. The data are therefore subject to improper interpretation, and are often too coarsely categorized for meaningful analysis.

SPREADING THE WORD

The Transportation Technology and Energy Branch (TT&E) of the Ontario Ministry of Transportation has used commercial vehicle accident survey data to identify accident causation factors, establish their role in the accident, and direct research in the area of commercial vehicle safety. This research has quantified stability characteristics, developed new vehicle configuration concepts, explored air brake system operation, and examined driver behavior. The research findings, some of which have been used to develop regulations and draft legislation, have been documented in a series of engineering reports. Unfortunately most of the documentation has been at a scientific level, replete with formulae and engineering terminology, understood by fellow scientists, but seldom shared with the person for whom this research is undertaken -- the professional truck driver.

The professional truck driver has been much maligned, but is where "the rubber meets the road". It is the driver that must translate scientific finding into cold, hard, fact. The OPP found that the major factor common to most truck drivers was their lack of understanding of the dynamic handling properties of the type of vehicle they were operating, and of the workings of both the brake and steering systems [6]. Industry can design and manufacture the "safest" truck but an uninformed driver can still defeat this intent. It is impossible to legislate common sense. The solution to many of the problems associated with commercial vehicle operation can be remedied by educating truck drivers. Similarly the often negative reaction from the trucking industry towards new regulation can be tempered by offering easily understood information on the regulation's purpose.

The TT&E Branch has adopted a policy that provides project documentation to both the scientific and lay communities. Video tapes are produced in-house using a script based on the written report, video segments taken during actual testing, some video graphics, and complimentary filler. The concepts are kept simple, everyday language is used, and the length of each video is kept to a maximum 10-15 minutes. This format has proven successful in reaching and informing a varied audience. An updated version of the first video made by the branch, "Stability of Heavy Trucks" [11], primarily intended for in-house use, is now widely circulated and is used by the OPP as a teaching tool.

CONCLUSIONS

An on-the-scene technical accident study is the best means of obtaining accident data. Although the sample may be small it is accurate because of the time spent on each accident and the technical expertise involved. Opinions are based on several viewpoints, and the investigation team is not bound by the Highway Traffic Act. Commercial vehicle accident investigation and reconstruction is a complex undertaking requiring sound organization and experienced personnel. If done well it is an invaluable source of information which, when used with mass accident data obtained from motor vehicle accident reports, can direct researchers, law enforcement, highway engineering, and legislation, and can promote safety in the industry.

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