# RAND *Europe*

## A Monitoring System for the Effects of Activities of Transport Inspectorate Netherlands on Traffic Safety

Final report

MR-1665-TIN

February 2002

**Ministry of Transport, Public Works and Water Management,**
**Directorate-General of Public Works and Water Management,**
**Transport Research Centre,**

and

**RAND Europe.**

**Team of authors**

This project was carried out by a team consisting of:

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# Preface

In this project for the Traffic Inspectorate Netherlands (TIN) the possibilities have been investigated of implementing instruments, developed in the United States (especially SafeStat, see below), to monitor the effects of the activities carried out by the Transport and Water Management Inspectorate, in Dutch 'Inspectie Verkeer en Waterstaat (IVW)', Transport Inspectorate Netherlands (TIN, 'Divisie Vervoer') to increase road traffic safety.

SafeStat is a set of rules, integrated in a software tool, to prioritize US motor carriers for safety inspections. Other instruments have been developed in the US for selecting vehicles for roadside inspections and for evaluating the effectiveness of road transport safety policy. The Dutch Ministry of Transport would like to develop a similar instrument for prioritizing carriers for inspection in the Netherlands, but also for assessing the effectiveness of the inspection activities (roadside inspections and on-site compliance reviews) carried out by TIN. The report contains a comparison of road safety aspects in the United States and The Netherlands, a description of the American tools and proposals for the development of similar tools in The Netherlands.

# Summary

In this report, proposals have been presented for a number of new monitoring and evaluation tools for road traffic safety in The Netherlands:

- *A tactical tool that can be used for selecting unsafe road freight transport firms* for:
  - compliance reviews and
  - roadside inspections.

  This tool calculates a safety score for every Dutch firm (carriers and shippers with own account transport) operating trucks for freights transport on the Dutch territory (either domestic transport or the Dutch parts of international transport). It is similar to SafeStat developed in the US. By focussing on the unsafe firms, the compliance reviews and roadside inspections can be done more effectively. This tool uses data from different sources:
  - the accident statistics from the Transport research Centre AVV-BG
  - data from the registration of IVW on the roadside inspections and the compliance reviews (BIC)
  - identifiers of vehicles and firms and information on the vehicle ownership per firm.

  This new tool distinguishes five areas of safety evaluation:
  - accidents
  - the driver
  - the vehicle/load
  - safety management
  - hazardous materials.

  Within each safety evaluation area, one or more measures are calculated which express safety (or rather unsafety) features of the firm. These measures are then converted into percentile scores (indicators). The indicators can be aggregated for each of the five areas and into an overall safety score for each firm, by weighting the various indicators according to their importance.

- *A strategic tool for the ex post evaluation of the effectiveness of the compliance reviews* (similar to the CRIAM –compliance review impact assessment model- developed in the US).

  We recommend that a subsample of the firms operating trucks that will receive a compliance review (CR) in some year will receive a questionnaire, both before and after the CR, with questions about the transport volume and accidents they were involved in. The same before and after survey should be done for a control group,

to separate the effects of the CR from other developments that might take place between the before-and-after survey.

If the tactical selection tool described above would be used to select unsafe carriers for compliance review, we recommend that not all firms are selected this way. For both the group of unsafe firms (selected using the tool) and for randomly selected firms, the before-and-after survey should then be carried out, for a subgroup of firms that received a CR and a control group, giving four groups in total.

- *A strategic tool for the ex post evaluation of the effectiveness of roadside inspections* (similar to the Intervention Model developed in the US).

  In the roadside inspections, deficiencies (e.g. overload, driving too long) are detected and also corrected. The heart of this tool would be a database of probabilities that a crash would occur if a deficiency had not been corrected. This database needs to be compiled in a number of expert sessions on truck safety.

  Once the risk probabilities per violation have been determined, the rest of the work would consist of:

  - Combining the numbers of violations observed with the risk probabilities to get numbers of crashes avoided.
  - Calculate the number of fatalities, injuries and damage-only-accidents for the avoided crashes, using average Dutch figures from the AVV-BG data.
  - Place a monetary value on fatalities, injuries and damage only accidents; these values might come from the national or international literature
  - Compare the monetary value of crashes avoided with the monetary cost of carrying out the inspections from IVW data in a cost-benefit analysis.

- *Methods for the strategic ex ante evaluation of actions* (continuation of current activities, introduction of new activities) of the IVW.

  The first three tools proposed above, all relate to ex post evaluation: determining the effectiveness of activities carried out by IVW in the past (or at present) or the present safety score of a firm. Some proposals have also been developed on ex ante evaluation: forecasting the effectiveness of activities of the IVW to increase road traffic safety in the future. These proposals are summarised below.

  The tools mentioned above for measuring the effectiveness of current activities of the IVW (such as compliance reviews and roadside inspections) can also be extrapolated into the future to give the expected impact of the continuation of such activities. This also applies to different ways of carrying out the compliance reviews and roadside inspections (e.g. on the basis of a tool selecting unsafe carriers for review and inspection versus the present selection of firms and vehicles without such a tool). The differences in effectiveness of two ways of selecting firms can be measured ex post by using both methods at the same time and interviewing firms selected using both methods. The ex post differences in effectiveness can be extrapolated into the future.

If one wants to evaluate (ex ante) the effects of continuing activities currently carried out (compliance reviews, roadside inspections) against effects of possible new activities (e.g. more emphasis on safety promotion campaigns, self-regulation in the transport sector, introduction of new technologies), then estimates of the effect of these new activities need to be made available. These could come from small-scale ('pilot') studies of such activities, results of research on the effects of such activities carried out elsewhere or expert opinions.

Another way to carry out ex ante evaluation, both for activities presently carried out and new ones, would be to develop an integrated causal model of accidents per firm. The above recommendations are all related to separate measurements of the effects on safety of individual activities. Developing a forecasting model of the number of accidents (by severity) of firms, that would include both external factors and policy variables would be a very ambitious effort. It has not been done in previous studies on road traffic safety in the Netherlands. The data to be used would consist of the AVV-BG accidents statistics linked to the data from the compliance reviews and roadside inspections from IVW.

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# 1. Introduction

## 1.1 Project goals

In this project the possibilities have been investigated of implementing instruments, developed in the United States (especially SafeStat), to monitor the effects of the activities carried out by the Transport and Water Management Inspectorate, in Dutch 'Inspectie Verkeer en Waterstaat (IVW)', Transport Inspectorate Netherlands (TIN, 'Divisie Vervoer') to increase road traffic safety. This project can be regarded as a follow-up of the literature review study of Traffic Test (1999) and the study about a framework for monitoring the activities of the IVW, carried out by Hague Consulting Group (1999) for the Transport Research Centre (AVV).

SafeStat is a set of rules, integrated in a software tool, to prioritize US motor carriers for safety inspections. Other instruments have been developed in the US for selecting vehicles for roadside inspections and for evaluating the effectiveness of road transport safety policy. The Dutch Ministry of Transport would like to develop a similar instrument for prioritizing carriers for inspection in the Netherlands, but also for assessing the effectiveness of the inspection activities (roadside inspections and on-site compliance reviews) carried out by IVW.

## 1.2 Data and tools used at the FMCSA

The FMCSA, the US Federal Motor Carrier Safety Administration, is responsible for traffic safety in the motor carrier industry. Motor carriers are freight transport firms (hire and reward firms and shipping firms with own account transport) with trucks with a weight exceeding 10,000 pounds or buses for more than 12 passengers, operating between states (including internationally). Unlike the IVW, FMCSA has no stated objectives in the area of social and working conditions in the transport sector. Since 1994, the FMCSA has concentrated on accounting for its performance and has been developing computer-based quantitative tools based on a large database with data about transport carriers operating interstate in the US. Also carriers from Canada and Mexico with a permit for USA are included. This database contains about 80.000 carriers of about 300.000 registered carriers, representing about 80% of the trucks on the interstate roads. Most of the States use this system at the moment. Data included are: involvement in accidents, violations by the driver of hours of driving and rest, traffic violations (as observed by FMCSA and the states), technical shortcomings of the vehicle and safety management of the carrier including hazardous materials (hazmats, e.g. type of material). These data are used in SafeStat to compute a safety-score per carrier (Safestat is available on internet). The data on hours of driving and resting in the USA are based on logbooks completed by the driver; a technological device such as the tachograph, currently used in Europe, has not been used in the US so far. The development of the database and models started as a small-scale pilot. Meetings with stakeholders are regarded as important success factors to attain acceptance and to make the models useful. SafeStat was originally developed for prioritising carriers for compliance reviews.

Before using the database the method of selection for roadside inspections was based on knowledge and intuition of the inspector. To make the method of inspection more systematic, more effective and efficient, an Inspection Selection System (ISS) was developed to select the carriers with the highest score on unsafety (now also from SafeStat) and the carriers of which the least information is available in the database. For this purpose inspectors use the US-DOT-number, a number carriers receive from US-DOT to operate interstate and which has to be visible at the side of the vehicle. This system is used by many states as a tool for selecting vehicles for inspection. The decision to select is always made by the inspector on the basis of the local and actual situation.

To determine the effectiveness of roadside inspections and inspections of carriers (compliance reviews), models have been developed and data on the last 2 years have been analyzed. These analyses have a descriptive character and are based on assumptions developed with knowledge and experience of experts in the field. The structure of these causal models was based on the demands of "stakeholders" (especially the inspectors, but also carriers, organizations representing carriers, shippers, assurance companies, etc.). Recently the methodology of these analyses has been improved substantially and is developing in the direction of causal (ex post-) evaluations identifying the effects of inspections. Some aspects still require attention: the quality of the data, the representativeness of the sample and the underpinning of assumptions on the effects of several components of the roadside inspection program, of the traffic enforcement program and of the compliance reviews.

The assignment of roles and tasks in recent years in the USA in developing knowledge and information for enforcement can be an inspiration for the Netherlands. In recent years the FMCSA in the USA has been developed into a more autonomous "administration" within the Department of Transport and has taken a lot of initiatives to make information on safety and policy implementation available: develop, maintain and improve a database, take initiatives for the management, for legal aspects, training, policy reporting (White House, Congress), information, etc. Volpe has an advising role, develops new systems and models in command of FMCSA and does complex studies such as evaluation studies. During our explorations of the last years no comparative developments have been found in other countries in which the enforcement of transport road safety is monitored as systematically as in the USA.

## 1.3 Contents of this report

The first step in this investigation is a comparison of the Dutch situation with regards to road traffic safety versus the situation in the United States. The outcomes of this first step are described in Part I of this final report. SafeStat and related instruments for monitoring and/or prioritizing motor carriers are described in Part II. A detailed proposal for implementation in the Netherlands can be found in Part III. In the annexes of this final report are the reports of AVV and RAND Europe on the visit to FMCSA and Volpe on 5-9 November 2001.

# PART I: Comparison of the Dutch and US traffic safety characteristics

# 2. Introduction to Part I

The key question to be answered in Part I of this study is the following.

*Can US instruments for giving safety ratings to carriers and for evaluation of road traffic safety policy be used in the Netherlands both for selecting unsafe carriers and for monitoring the effects of the activities of Transport Inspectorate Netherlands, or are there differences between both countries, which preclude such implementation?*

This key question can be broken down into a number of specific questions:

1. Are there differences in the road traffic accident rates and in the factors that influence road traffic safety that preclude an implementation of American tools like SafeStat in the Netherlands?

2. Are there differences in the legal and administrative framework that preclude an implementation of American tools like SafeStat in the Netherlands?

3. Are there differences in the work that the inspection agencies (FMCSA and IVW) carry out that preclude an implementation of American tools like SafeStat in the Netherlands?

4. If the above questions can be answered 'no', are the types of data that Safestat and related instruments require available in the Netherlands?

5. If Safestat and related instruments can be implemented in the Netherlands, are there specific differences between both countries, which need to be taken into account in the development of tools for the Netherlands?

In chapter 3 of this report, material related to the first question will be presented. Similarities and differences between the relevant demographic, socio-economic and traffic network characteristics of the two countries will be presented first. Subsequently, the crash-rates, injuries and fatalities will be summarized, focusing on commercial vehicles. The fourth chapter will deal with the laws and policies for the United States and the Netherlands related to traffic safety on the roads (the second specific question mentioned above). In the fifth chapter information on inspections by the FMCSA and IVW will be given, and the data items, that are required as input for SafeStat, will be compared. This relates to the third and fourth of the above specific questions. Material for answering the fifth specific question is covered in the chapters 3-5. Finally, in chapter 6 conclusions will be drawn, separately for each of the specific questions and the key question, as listed in this chapter.

*Data*

The data for the United States are provided by the National Transport Statistics 2000 (NTS 2000) and the Federal Motor Carrier Safety Administration (FMCSA). Data for the latter can be accessed freely on the Internet (www.fmcsa.dot.gov).

The 'Centraal Bureau voor Statistiek (CBS), 'Transport Logistiek Nederland (TLN) and the Ministry of Transport have provided the Dutch data.

All the distances in the statistics for the United States are originally given in miles. For convenience all quoted distances were recalculated to kilometers in this report (1 mile = 1.609 kilometers and 1 square mile = 2.589 square kilometers).

The Dutch and US data are not completely compatible. Aggregation over categories is made to achieve the best possible comparison. To make a fair comparison between two countries, percentages with respect to area size or population are given when appropriate. For the comparison the most recent available data was used.

# 3. Factors influencing traffic safety

This chapter will describe the demographic and social-economic situation of the Netherlands and the United States. Statistics of crash-rates, injuries and fatalities are given in sections 3.8 - 3.10.

## 3.1 Population and area size

A major difference between the Netherlands and the United States is, of course, geographic area size and population. Weighing the relevant numbers by the population size or the total area will give a better indication of the similarities or differences of the two countries.

Table 1 gives an overview of the age-category- and sex distribution for the total population in the US and the Netherlands in 1998, the total area and the population density.

**Table 1 Population characteristics for the Netherlands and the United States in 1998**

| 1998 | NL inhabitants (x1000) | | US inhabitants (x1000) | |
|---|---|---|---|---|
| Under 18 | 3438 | 22.0% | 69903 | 25.9% |
| 18-24 | 1357 | 8.7% | 25476 | 9.4% |
| 25-34 | 2588 | 16.5% | 38743 | 14.3% |
| 35-44 | 2452 | 15.7% | 44498 | 16.5% |
| 45-54 | 2208 | 14.1% | 34575 | 12.8% |
| 55-64 | 1501 | 9.6% | 22666 | 8.4% |
| 65+ | 2110 | 13.5% | 34385 | 12.7% |
| | | | | |
| Male | 7740 | 49.4% | 132030 | 48.9% |
| Female | 7914 | 50.6% | 138218 | 51.1% |
| | | | | |
| Total | 15654 | | 270248 | |
| | | | | |
| Total area (km²) | 41500 | | 9625000 | |
| Density | 377 per km² | | 28 per km² | |

Source: US; NTS 2000, NL; CBS, Statline, Statistisch Jaarboek 2001

The share of people below the age of 24 is larger in the United States than in the Netherlands. Furthermore, the US has a smaller share of persons above the age of 45.

The population density in the Netherlands is about 13 times the population density in the United States. This has a great influence on the traffic situation.

## 3.2 Occupation

For the United States as well as the Netherlands there are extensive transport employment statistics. However, the categories are different for the two countries. Table 2 gives an overall impression of the numbers of people employed in the transportation sector expressed as a percentage of the total workforce. These numbers do not include the people working in firms in non-transport sectors with own account transport.

**Table 2 Occupational statistics for the Netherlands and the United States in 1998**

| 1998 | Netherlands | | United States | |
|---|---|---|---|---|
| Total workers (x 1000) | 6.957 | | 131.463 | |
| Motor vehicle operators [1] (x 1000) | 203 | 2.9% | 4.069 | 3.1% |
| Truck drivers (x 1000) | 123 | 1.8% | 3.012 | 2.2% |
| Bus drivers (x 1000) | 33 | 0.5% | 490 | 0.4% |

Source: US; National Transportation Statistics 2000, NL; CBS, Statline, Werkgelegenheid transportbedrijven, SBI, Tram -en autobus bedrijven & Taxibedrijven & Goederenwegvervoerbedrijven totaal & Koeriersdiensten, CBS Statistisch Jaarboek 2001.
[1] See Appendix A for a definition

The distribution of drivers in the transport sector is similar in the two countries.

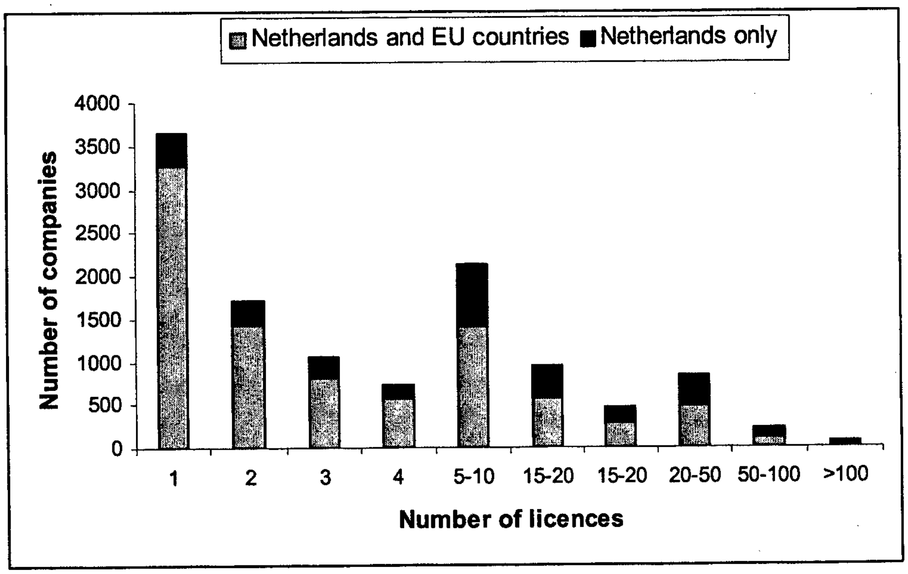
Table 3 and Figure 1 give an indication of the number of the licensed hire-and-reward companies active in the freight transport sector in the Netherlands in 2000 (this implies that own account transport is not included here). Every company that has a license for EU countries automatically has a license for the Netherlands.

**Table 3 Number of companies by number of truck licenses in the Netherlands in 2000**

| Number of licenses in 2000 | Number of companies in the Netherlands | | | |
|---|---|---|---|---|
| | License for the Netherlands | | License for EU | |
| 1 | 3644 | 29.8% | 3265 | 34.0% |
| 2 | 1706 | 14.0% | 1431 | 15.0% |
| 3 | 1056 | 8.6% | 822 | 8.6% |
| 4 | 727 | 5.9% | 567 | 5.9% |
| 5-10 | 2123 | 17.4% | 1396 | 14.6% |
| 10-15 | 949 | 7.8% | 581 | 6.1% |
| 15-20 | 466 | 3.8% | 287 | 3.0% |
| 20-50 | 846 | 6.9% | 488 | 5.1% |
| 50-100 | 213 | 1.7% | 119 | 1.2% |
| >100 | 71 | 0.6% | 37 | 0.4% |
| Unknown | 426 | 3.5% | 549 | 5.8% |
| Total (licensed) companies | 12.227 | | 9.542 | |
| Total number of licenses | 100.736 | | 59.820 | |

Source: TLN, 2000

**Figure 1** Number of hire-and-reward companies in the Netherlands by number of truck licenses for the Netherlands and EU countries in 2000




Source: TLN 2000

In the Netherlands there are 56.728 companies active (and licensed) in the own account transport sector in 1999 (MinVenW-web-site SIEV). They have 203.708 licenses in total. When companies 'share' a truck, multiple licenses can be issued. Hence, the number of licenses exceeds the number of trucks.

According to MCMIS (Motor Carrier Management Information System) Census File the United States has 505.900 active interstate motor carriers and 41.851 hazardous materials carriers in October 1998.

In 1998 the number of motor carriers (hire-and-reward) in the Netherlands was 0.001 per person. In the United States the average is 0.002.

## 3.3 Vehicle fleet

For a comparison of the statistics a uniform definition of a truck or large truck is needed. In the United States a large truck is defined as a truck with a gross vehicle weight rating (GVWR, see appendix A) greater than 10,000 pounds or 4536 kilograms.

In the Netherlands a large truck ('vrachtauto') is defined by the CBS and TLN (Transport Logistiek Nederland) as a vehicle with a gross vehicle weight of 3500 kilograms. The definitions of a large truck are therefore similar, but not identical. In the table below, we use the above definitions.

Table 4 gives an overview of the Dutch and US vehicle fleet.

**Table 4 Vehicle fleet in the Netherlands and the United States in 1998**

| Motor Vehicles 1998 (x 1000) | Netherlands | | United States | |
|---|---|---|---|---|
| Passenger Cars | 5.931 | 84% | 131839 | 61% |
| Motorbikes | 373 | 5% | 3879 | 2% |
| NL: Vans, US: 2-axle vehicles 4-tires [1] | 574 | 8% | 71330 | 33% |
| Trucks (total, NL: 'vrachtauto+oplegger', US: 2-axle vehicles 6-tires +combination trucks) | 124 | 2% | 5735 + 1997 = 7732 | 4% |
| Bus + Special vehicles | 40 | 1% | 716 | 0% |
| Total | 7042 | 100% | 215496 | 100% |
| | | | | |
| Inhabitants | 15654 | | 270248 | |
| | | | | |
| Vehicles per inhabitant | 0.45 | | 0.80 | |
| Vehicles per squared kilometer | 170 | | 22.4 | |
| Passenger cars per inhabitant | 0.38 | | 0.49 | |
| Motorbikes per inhabitant | 0.02 | | 0.01 | |
| 2-axle vehicles 4-tires per inhabitant [1] | 0.04 | | 0.26 | |
| Trucks per inhabitant | 0.008 | | 0.029 | |
| Buses per inhabitant | 0.0026 | | 0.0026 | |
| | | | | |
| Bikes | 13072 | | N/A | |

Source: US: NTS 2000, NL: CBS, Statistisch Jaarboek 2001, Statline 2001
N/A: no data available
[1] for the Netherlands these are statistics for vans 'bestelauto' and trucks below 3500 kilograms

Comparisons of the vehicle populations are hampered by the differences in the definitions of passenger cars and trucks.

Vehicles in the United States are divided in two extra categories: 2-axle (4-tires) vehicles and 2-axle (6-tires) vehicles. The 2-axle 4-tires vehicles could be used for private travel, just as a passenger car, but also for freight transport. If these are added to the passenger cars, this results in a car ownership of 0.75 cars per person in the United States In the Netherlands a 2-axle (4-tires) vehicle is not a standard category, a van (in Dutch 'bestelauto') was classified under this heading.

The 6-tires vehicles are categorized as a truck, which is in line with the NTS data. This category includes vehicles above 4536 kilograms.

According to CBS data (Statline 2000) there are 6290 trucks ('vrachtauto's en trekkers') weighting between 3500-4500 kilograms, roughly one percent of the total amount of trucks. The truck ownership rate in the Netherlands (uncorrected or corrected for 1%) is significantly lower than in the United States.

The level of motorisation is much higher in the United States, but the density of vehicles is higher in the Netherlands. A high level of motorisation will, ceteris paribus, increase the probability of a crash (but also to fewer accidents with pedestrians), as could be said for a high vehicle density.

## 3.4 Age of the vehicle

In 1998 the median age of an automobile in the United States was 8.3 years and a truck 7.6 years. Transit buses are given in five categories ranging from an average age of 4.0 years for small buses to 14.6 years for trolley buses (NTS, 2000).

According to CBS data (Statline 2000) the median age of an automobile in the Netherlands in 1998 was 5.9 years. For trucks, frequencies are listed for the years they were built (TLN, 2000). Over 30 % percent was built before 1990 and almost 49 % before 1993. Detailed information is available for the last ten years in the Netherlands. Assuming a symmetric distribution, this means an average age of 7 or 8 years, which is comparable with the average age of 7.6 in the US. For the age of buses in the Netherlands, there are no figures available.

## 3.5 Weight of a truck

Detailed weight information for trucks in the US is not available, although there is a distinction between light and heavy trucks (borderline at 10.000 pounds). The Dutch CBS publishes a distribution of the truck population by weight (Table 5).

**Table 5 Weight distribution of unloaded trucks (horse or 'trekkers' and rigids or 'vrachtauto's') in the Netherlands in 1998**

| 1998 | Trucks (tractor units, for trailers) | Trucks (rigids) | Trucks (total) |
|---|---|---|---|
| | | | |
| **3500-4000** | N/A | 2918 | 2918 |
| **4000-4500** | 56 | 3316 | 3372 |
| **4500-5000** | 176 | 4007 | 4183 |
| **5000-6000** | 2300 | 7498 | 9798 |
| **6000-7000** | 24005 | 7395 | 31400 |
| **7000-8000** | 18817 | 8087 | 26904 |
| **8000-9000** | 2076 | 11047 | 13123 |
| **9000-10000** | 557 | 7930 | 8487 |
| **10000-11000** | 253 | 7045 | 7298 |
| **11000-12000** | 177 | 5448 | 5625 |
| **12000-13000** | 88 | 3810 | 3898 |
| **13000-14000** | 58 | 2534 | 2592 |
| **14000-15000** | 17 | 1553 | 1570 |
| **15000-16000** | 18 | 941 | 959 |
| **> 16000 kg** | 66 | 1889 | 1955 |
| **Total** | 48664 | 75418 | 124082 |

Source: CBS, Statline 2001

## 3.6 Road Network

In the Netherlands the length of the road network is recorded as freeways, urban roads and rural roads. For the United States the road network is divided into different categories both for rural and urban areas: interstates, other principal arterials, minor arterials and major collectors. For the urban areas there is an extra road type, other free/express ways.

An overview of the length is given in Table 6.

**Table 6 Traffic Network in the Netherlands and the United States in 1998**

| Netherlands (kilometers) | | | United States (kilometers) | Rural | | Urban | |
|---|---|---|---|---|---|---|---|
| **Freeways** | 2235 | 2% | **Interstate** | 52793 | 4% | 21353 | 1% |
| **Urban roads** | 56407 | 49% | **Other Principal arterials** | 159061 | 11% | 85489 | 6% |
| **Rural roads** | 57451 | 49% | **Minor Arterials** | 220843 | 15% | 142665 | 10% |
| | | | **Major Collectors** | 625093 | 43% | 139508 | 10% |
| | | | **Other Free/Express ways** | None | | 14753 | 1% |
| | | | | 1057790 | 72% | 403768 | 28% |
| **Total** | 116093 | 100% | **Total** | 1461558 | | 100% | |
| **Area size** | 41500 | | | 9625000 | | | |
| **Kms/area size** | 2.80 | | | 0.15 | | | |

Source: US: NTS 2000, NL: CBS, Statistisch Jaarboek 2001.

Rural roads account for more than two-third of all the roads in the United States, while the Dutch network has almost as much rural roads as urban roads.

The traffic network is much denser in the Netherlands than in the US (about 18 times). This could partly be explained by the fact that the population density is higher in the Netherlands (about 13 times).

## 3.7 Vehicle kilometrage

The data on passenger kilometrage is hard to compare. The NTS-data and the data of the CBS are built up in a different way. The NTS has both the vehicle type and the road type as category, while the CBS makes a distinction only by mode.

Table 7 and Table 8 give an impression of the kilometrage for the Netherlands and the US in 1998.

**Table 7 Vehicle kilometrage in total, per person and per vehicle in 1998 for the Netherlands**

| 1998 | Netherlands (in millions) | | Per person | | Per vehicle | |
|---|---|---|---|---|---|---|
| **Car kilometers** [1] | 85.500 | | 5.462 | | 12.921 | |
| **Car driver and passenger kilometers** [2] | 137.100 | | 8.758 | | 20.719 | |
| | | | **Per bus driver** | | **Per bus** | |
| **Bus kilometers** | 641 [3] | | 5.211 | | 15.634 | |
| **Bus passenger kilometers** | 10.866 | | 88.341 | | 269.415 | |
| ***Within the Netherlands*** [4] | | | **Per truck driver** | | **Per truck** | |
| | **Hire and reward** | **Own-account** | **Hire and reward** | **Own-account** | **Hire and reward** | **Own-account** |
| **Truck kilometers** | 2.489 | 1.353 | 20.236 | - | 20.059 | 10.904 |
| **Truck tonkilometers** | 22.914 | 5.606 | 186.293 | - | 184.668 | 45.180 |
| ***Outside the Netherlands*** | | | **Per truck driver** | | **Per truck** | |
| | **Hire and reward** | **Own-account** | **Hire and reward** | **Own-account** | **Hire and reward** | **Own-account** |
| **Truck kilometers** | 2.621 | 447 | 21.309 | - | 21.123 | 3.602 |
| **Truck tonkilometers** | 38.060 | 1.576 | 309.431 | - | 306.732 | 12.701 |

Source: CBS, Statistisch Jaarboek 2001, TLN 2000

[1] motorbikes excluded, based on OVG, before 2000 based on OVG and PAP (1998: 90.400)

[2] driver- and passenger kilometers, based on OVG, before 2000 based on OVG and PAP (1998: 142.100)

[3] defined by the CBS as 'effective vehicle kilometers' (in Dutch 'nuttige voertuigkilometers'), probably an underestimation of the total bus kilometers.

[4] By vehicles registered in the Netherlands. The vehicle kilometrage by foreign trucks is not included (unknown).

**Table 8 Vehicle kilometrage in total, per person and per vehicle in 1998 for the United States**

| 1998 | US (in millions) | Per person | Per vehicle |
|---|---|---|---|
| **Car kilometers** [1] | 3.890.323 | 14.266 | 19.148 |
| **Car passenger kilometers** [2] | 6.255.467 | 22.940 | 30.789 |
| | | **Per bus driver** | **Per bus** |
| **Bus kilometers** | 11.274 | 23.008 | 15.746 |
| **Bus passenger kilometers** | 238.655 | 487.051 | 333.317 |
| | | **Per truck driver** | **Per truck** |
| **Truck kilometers** | 315.975 | 104.905 | 40.866 |
| **Truck tonkilometers** | 1.652.443 | 548.620 | 213.715 |

Source: NTS
[1] including 2-axle 4-tire vehicles, motorbikes excluded
[2] driver- and passenger kilometers

The distances for US cars and buses are larger than for the Dutch. This is not surprising, when one takes the area size of both countries into account.

The Dutch trucks produce more tonkilometers in foreign countries than in The Netherlands itself. In Table 7 the truck kilometers are given for transport inside and outside the Netherlands. Hire-and-reward transport and own-account transport have been split up as well. Adding the truck tonkilometers in- and outside the Netherlands for the hire-and-reward sector per truck driver gives a figure that comes close to the tonkilometers per truck driver for the US.

The number of kilometers per truck driver in the US is 2.5 times the Dutch number of kilometers per truck driver (inside and outside the country), but measured per truck the number of kilometres in both countries is about the same. The number of truck tonkilometers per truck driver is slightly higher in the US, but per truck the Dutch number of tonkilometers is 2.5 times the US figure. This implies that on average the truckloads in the US are smaller, which we find difficult to explain.

In the Netherlands, the total amount of goods for international transport in 1999 was 176.307 tons. Foreign motor carriers transported 35% (61696 tons), which indicates that there are many non-Dutch trucks on the Dutch roads.

## 3.8 Transportation crashes, injuries and fatalities

There exists an enormous amount of data in both countries regarding road traffic accidents, crashes, injuries and fatalities. It would be too exhausting to report all the available data here. The main focus is on truck and bus accidents, although there are statistics for accidents recorded by day, age, alcohol involvement, for the time of day, the weather conditions and speed.

In total 6.624.000 road traffic crashes were reported in the US in 1997 (NTS 2000). In the Netherlands in 1997 the number of road traffic accidents was estimated at 1.156.000 (Verkeersongevallen, 1997). About 300.000 of these were reported by the police. The figure 1.156.000 is the result of an expansion procedure to include all accidents with fatalities, injuries and property damage 'worthy of registration'. Both the US and Dutch figures include the crashes with property damage only (PDO, in Dutch 'Uitsluitend Materiële Schade (UMS)'). More recent data is available for the US. Because of insufficient registration of the PDO crashes and possible differences in the registration rates for such accidents in both countries (also see below), the above total numbers of crashes are hard to compare. However, the statistics for fatalities can meaningfully be compared and to a lesser extent the injury statistics.

The Dutch accident data are based on reports of accidents, which are completed by police officials. These data represent virtually all fatal accidents, some 60% of all serious injury accidents, 40% of minor injury accidents and less than of 10% property damage only accidents. AVV (Transport Research Centre) and the Central Bureau for Statistics use these data to publish the official annual road safety statistics. In the United States injury statistics represent all injuries reported at the scene of the accident. These injuries include both major and minor injuries.

Table 9 shows the trends in injuries and fatalities for 1990, 1995 and 1998 in the US and the Netherlands.

**Table 9 Trends: injuries and fatalities in the United States and the Netherlands.**

| Year | United States | | Netherlands | |
|---|---|---|---|---|
| | Injuries | Fatalities | Injuries [1] | Fatalities |
| 1990 | 3231000 | 44599 | 20750 | 1376 |
| 1995 | 3465000 | 41817 | 20000 | 1334 |
| 1998 | 3192000 | 41501 | 18620 | 1066 |

Source; US: NTS 2000, NL: Verkeersongevallen 1997 & 1999.
[1] only hospitalized injuries

In spite of the growing motorisation in both countries the absolute numbers of injuries and fatalities show a declining trend.

For 1998 the number of fatalities and injuries of occupants are specified by mode in Table 10. Note that these numbers indicate fatalities and injuries of people who are actually inside the vehicle at the moment of the accident. People waiting at the bus stop (for instance) are reported as pedestrians.

**Table 10 Injuries and fatalities by mode in the United States and the Netherlands in 1998**

| 1998 | US injuries | | US fatalities | | NL injuries [1] | | NL fatalities | |
|---|---|---|---|---|---|---|---|---|
| Passenger car | 2.964.000 | 93% | 31.899 | 77% | 28.820 | 27.5% | 582 | 55% |
| Truck/bus | 29.000 | 1% | 742 | 2% | 1.290 | 1.2% | 11 | 1% |
| Motorcyclist | 49.000 | 2% | 2.294 | 6% | 5.010 | 4.8% | 76 | 7% |
| Pedalcyclist | 53.000 | 2% | 761 | 2% | 63.270 | 60.4% | 283 | 27% |
| Pedestrian | 69.000 | 2% | 5.228 | 12% | 5.040 | 4.8% | 110 | 10% |
| Other | 12.000 | 0% | 540 | 1% | 1.290 | 1.2% | 4 | 0% |
| Total | 3.192.000 | 100% | 41.501 | 100% | 104720 | 100% | 1.066 | 100% |

| Total Population | 270248000 | | 15654000 | |
|---|---|---|---|---|
| In % of population | Injuries | Fatalities | Injuries | Fatalities |
| Passenger car | 1.097% | 0.0118% | 0.184% | 0.0037% |
| Truck/bus | 0.0107% | 0.0003% | 0.008% | 0.0001% |
| Motorcyclist | 0.0181% | 0.0008% | 0.032% | 0.0005% |
| Pedalcyclist | 0.0196% | 0.0003% | 0.404% | 0.0018% |
| Pedestrian | 0.0255% | 0.0019% | 0.008% | 0.0007% |
| Other | 0.0044% | 0.0002% | 0.008% | 0.0000% |
| Total | 1.1811% | 0.0153% | 0.666% | 0.0068% |

Source: US: NTS, 2000, NL: AVV, Verkeersongevallen, 1999
[1] 'SEH-gewonden (Spoedeisende Eerste Hulp)+ ziekenhuisgewonden'

The rate of reported fatal crashes to population in the US is higher than in the Netherlands (Table 10). Other comparisons are difficult, because of insufficient registration of non-fatal accidents.

Table 10 shows that the relative number of deaths and injuries for cyclists in the Netherlands is much higher. This can be explained by the large amount of cyclists and trips by bike in the Netherlands.

Table 11 gives an impression of the number of fatalities by road type in the United States. In the Netherlands injury statistics by road type are available for large trucks and vans. They will be presented in the next paragraph.

**Table 11 Fatalities by road type for all vehicles in the United States in 1998.**

| 1998 | United States | | | | Vehicle kilometers travelled (millions) | | | |
|---|---|---|---|---|---|---|---|---|
| | Rural | | Urban | | Rural | F/km [1] | Urban | F/km [1] |
| Interstate | 3.105 | 7.6% | 2.283 | 5.6% | 404696 | 0.007 | 602767 | 0.004 |
| Other arterial | 9.594 | 23.5% | 9.902 | 24.2% | 649206 | 0.015 | 1388557 | 0.007 |
| Collector | 7.593 | 18.6% | 1.037 | 2.5% | 414894 | 0.018 | 212258 | 0.005 |
| Local | 4.459 | 10.9% | 2.921 | 7.1% | 194037 | 0.023 | 367705 | 0.008 |
| Subtotal | 24.751 | 60.5% | 16.143 | 39.5% | 1662833 | 0.0149 | 2571287 | 0.006 |
| | | | | | | | | |
| Total | 40.894 | | | | 4234120 | | 0.010 | |

Source: NTS 2000

[1] Fatalities per 1 million travelled kilometers

The number of fatalities is higher on rural roads. However if the length of the rural and urban road network (Table 6) is taken into account, fatality accidents are more likely to occur on urban roads. The share of fatalities on interstates is higher than the share of the interstates in the total road network. Other categories are not comparable.

The number on fatalities per vehicle kilometer indicates that interstate highways in the US are the safest road type both in urban and rural areas. Local roads are comparatively unsafe.

## 3.9 Large truck crashes

In this paragraph we will focus on truck crashes with large trucks (in Dutch 'vrachtauto's'). The numbers indicated in Table 12 are all injuries and fatalities caused by a crash where a truck is involved, which are considerably higher than the numbers for truck occupants only (cf. Table 10).

**Table 12 Truck crashes in the United States and the Netherlands in 1997**

| 1997 | US | | Netherlands | |
|---|---|---|---|---|
| Crashes | 421.000 | | 20.327 | |
| Property Damage Only (PDO), in Dutch 'Uitsluitend Materiële Schade (UMS)' | 325.000 | 77.2% | 18.464 | 90.8% |
| Number of injuries | 131.000 | | 2.222 | |
| Injuries per crash | 0.31 | | 0.11 | |
| Number of fatalities | 5.398 | | 168 | |
| Fatalities per crash | 0.013 | | 0.008 | |

Source: US: FMCSA 1999 Large Truck Crash Facts, NL: Verkeersongevallen, 1997

If all trucks and vans ('bestelauto's') are included, the number of fatalities per year in the Netherlands is 319 (source: DGG: Beleidsplan verkeersveiligheid goederenvervoer over de weg 2000-2005).

Table 13 gives the statistics in 1999 for the total number of large trucks involved in an accident and the rate per million vehicle kilometers travelled in the two countries.

**Table 13 Large trucks involved in an injury crash in the United States and the Netherlands in 1999**

| 1999 | United States | Netherlands |
|---|---|---|
| Trucks involved | 101.000 | 846 |
| Million vehicle kilometers | 320.643 | 6.523 |
| Vehicles involved in an accident per million kilometers | 0.31 | 0.13 |

Source: US: FMCSA 1999 Large Truck Crash Facts, NL: TLN 2000

Table 13 indicates that the probability for a truck to be involved in an injury accident is significantly higher in the United States.

The FMCSA keeps records of the fatal crashes by driver-related factors and violations. Roughly 38% of the fatal crashes in 1999 were related to driver errors. The three most common failures were: failure to keep in the proper lane or running off road (11.9%), driving too fast (7.3%) and inattentiveness like talking or eating (5.1%).

In the Netherlands some data relating to the causes of accidents are available for the different road categories during the period 1994-1997. The three causes with the (nominal) highest values were: making improper turn, not giving way and driving too much to the right.

Table 14 gives an impression of the number of crashes for trucks by road type for the Netherlands in 1997.

**Table 14 Crashes by road type for trucks and vans in the Netherlands in 1997.**

| 1997 | Netherlands | | | |
|---|---|---|---|---|
| | Trucks | | Vans | |
| Freeways ('national roads') | 4214 | 20.7% | 4299 | 11% |
| Major road ('provinciaal wegennet') | 2055 | 10.1% | 3284 | 9% |
| Minor road ('gemeentelijk wegennet)' | 14058 | 69.2% | 31009 | 80% |
| | | | | |
| Total | 20327 | | 38592 | |

Source: DGG, 2000

The share of injuries on highways is much higher than the share of the length of highways in the total road network. There are no statistics available for the vehicle kilometers for all road types in the Netherlands.

## 3.10 Hazardous materials

There is a global consensus on the fact that accidents involving hazardous materials have a great impact both on the persons involved in the accident as well as the surrounding area. The German study BAST (1998) for instance found that about 50% more fatalities are reported for accidents with hazardous materials, although most of the fatalities were not due to the hazardous materials themselves.

However, the registration in the Netherlands on accidents where hazardous materials are involved is poor. (VeVoWeg, Min. V&W et al. 1998). Due to the limited number of accidents, analysis is difficult and not statistically reliable.

In the United States the FMCSA reports a total of 4898 fatality crashes in 1999 in which large trucks were involved. In 213 crashes (4.3%), trucks carrying hazardous materials were involved.

Due to the poor registration of accidents involving hazardous materials in the Netherlands no comparison with American data could be made.

# 4. Policy & Regulations

## 4.1 Policy objectives

The United States and the Netherlands have both set targets to improve safety on the roads. The mission of the Federal Motor Carrier Safety Administration (FMCSA) is to reduce Commercial Truck-Related Fatalities by 50% in 2010 relative to 2000 and the number of persons injured in Large-Truck crashes by 20% (FMCSA Safety Program, 2000). The secondary goal is to reduce incidents with hazardous materials transportation.

The Dutch government has set its aims for a total reduction of 50% in fatalities for all modes and 40% less serious injuries in 2010 relative to 1986 (National Transport Plan (NVVP)). For 1998 to 2010 this means a reduction of 300 fatalities and 4600 serious injuries.

There are no quantitative goals set for individual companies or sectors within the road transport environment, although qualitative objectives to reach a higher level of safety are described for freight transport in 'Beleidsplan verkeersveiligheid goederenvervoer 2000-2005' (DGG 2000).

## 4.2 Regulations

Due to great differences between laws of US states, we will compare only the federal laws of the United States with the laws in the Netherlands. It is not our aim to look at the jurisdictional regulations in detail, but give a more practical description for both countries.

## 4.3 Drivers license

In the US commercial vehicle drivers and in the Netherlands truck drivers, require special training and extra quality above those required for a passenger car. In the Netherlands and the United States one has to pass specific theoretical and practical exams in order to be allowed to drive commercial vehicles or large trucks. For trucks carrying hazardous materials even more theoretical and practical exams should be passed.

In the United States the age limit for a passenger car license differs between states (from 15-18 year, sometimes with provisional licences). For (commercial) motor vehicles there is a federal minimum of 21 years. In the Netherlands the age limit is 18 for passengers cars, trucks and buses. In the Netherlands limits are imposed by national law. In the United States the minimum standards to be allowed to drive a commercial vehicle is set at federal level. Each state may have additional regulations.

In the Netherlands every truck that can carry a load of more than 500 kilograms has to have a permit. The 'Stichting Nationale en Internationale Wegvervoer Organisatie' (NIWO) will test a company on reliability, credibility and skill (of the drivers) before issuing a permit. Own-account transport licenses are issued by the 'Stichting Inschrijving Eigen Vervoer' (SIEV). Violating regulations or laws can ultimately lead to a withdrawal of the license.

A motor carrier (see Appendix for definition) in the US must have a permit according to the Motor Carrier Property Permit Act (1996), which is issued by the Motor Carrier Permit (MCP) Branch. The MCP Branch is responsible for issuing motor carrier permits, which contain information specific to the motor carrier, i.e., name, mailing address and effective/expiration dates of the permit. Additionally they verify proof of liability and workers' compensation, collect and allocate permit fees, maintain electronic motor carrier data and provide necessary information to enforce public safety.

## 4.4 Maximum Speed

The general maximum speed limits for both countries are given in Table 15. Local limits can deviate. There are no separate limitations for trucks in the United States, although the speed limits might differ by state.

**Table 15 Maximum speed limits in the United States and the Netherlands**

| | US (km/h) | Netherlands | |
|---|---|---|---|
| | All vehicles | Passenger car | Truck |
| **Highway** | 104.6-120.7 (65-75 miles) | 100-120 | 80 |
| **Urban areas** | 56.3 (35 miles) | 50 | 50 |
| **Rural areas** | 88.5 (55 miles) | 80 | 80 |

## 4.5 Alcohol

The regulations for drink-and-drive in the Netherlands and the US are slightly different. In the US you are not permitted to drive when the alcohol concentration is above 0.08 or 0.1 grams/dl depending on state laws, and no more then 0.04 grams/dl for Commercial Motor Vehicle-drivers. The Dutch law regards more than 0.05 grams/dl as an offense for all drivers. Within six months a new law will probably be adopted, which will set a maximum limit of 0.02 grams/dl for persons below the age of 24.

The difference between Dutch and American maximum alcohol limit is rather small.

## 4.6 Maximum driving time

In the Netherlands the maximum driving time is defined as the longest time you may drive a vehicle for a consecutive period. In the US there is both a maximum limit for the actual time that a vehicle is driven and for the time the driver is on duty, which means driving and including loading/offloading, maintenance, etc..

The rules on maximum driving and duty time in the United States (Federal Motor Carrier Safety Administration) can be summarized as follows:

- No more than 10 hours driving time following 8 consecutive hours off duty: or
- No more than 15 hours on duty following 8 consecutive hours off duty: and
- No more than 60 hours driving time in any 7 consecutive days: or
- No more than 70 hours driving time in any 8 consecutive days.

The full legal text is given on the webpage of the FMCSA.

The Dutch situation is quite different: there is a maximum driving time and a minimum rest-time (off duty time). Indirectly, through the rest time requirements, there are also rules for the duty time.

The definition of the maximum driving time in the Netherlands (IVW) can be summarized as follows:

- A maximum driving time of 9 hours per day, except on two days per week, when 10 hours are allowed. Consecutive driving time is limited to a maximum of 4,5 hours, then a minimum rest period of 45 minutes is required.
- No more than 56 hours in 7 consecutive days: and
- No more than 90 hours in 14 consecutive days

Taking into account rest periods, this implies a working day of up to 11 consecutive hours.

There are further regulations for Sundays and night work, but these are not as restrictive as the maximum driving time. There are no equivalents for these in the United States.

## 4.7 Recording devices

With the exception of private motor carrier of passengers (nonbusiness), every motor carrier shall require every driver employed by the motor carrier to record his/her duty status for each 24hour period. This regulation is the same in both countries. The exact administration of the status may differ, as well as the means of registration, digitally or by hand.

# 5. Practice

To monitor the performance of the IVW, data of inspections have to be analyzed. This chapter will describe the data of inspections both in the US and the Netherlands, which are used as input for Safestat and could be used as input in the Dutch monitoring instrument. However, not all input data for Safestat are accessible in the Netherlands. Furthermore this chapter also provides information on the responsibilities of the IVW and FMCSA.

Safestat (Safety Status Measurement System) uses five datasources, which will be discussed briefly in the following paragraphs, as well as the Dutch counterparts.

## 5.1 Responsibilities of IVW and FMCSA

The FMCSA carries out some 12,000 compliance reviews per year. The roadside inspections (more than 2 mln per year) are not done by the FMCSA itself, but by its State counterparts (the FMCSA allocates the budgets for these).

There is an important discrepancy between the duties of the FMCSA and the Dutch IVW. The FMCSA and the State counterparts are authorized to perform inspections regarding the technical state of a vehicle. The IVW does not perform these inspections. In the Netherlands these are carried out by the police.

More in general, we can say that several institutes in the Netherlands carry out roadside inspections:

- The police (e.g. the KPLD)
- The environmental inspectorate ('Inspectie Milieuhygiëne) of the ministry of the environment
- The customs agency ('douane')
- The IVW.

Except for some occasional big national campaigns, the inspection activities of these various agencies are not centrally planned or coordinated. The agencies mentioned are responsible for their own inspection activities. They set their own priorities and can use different norms in their inspections. In practice it is up to these agencies to decide whether they focus on inspecting the unsafest vehicles or not, and which rules they use for selecting these. In the US there are also several agencies with responsibilities for enforcement of safety regulation for goods transport by road: the FMCSA and its State counterparts, but also the police for traffic enforcement (e.g. speeding, disobeying traffic lights, drunken drivers).

## 5.2 Reported Crash Data

In the United States, State-Reported Commercial Vehicle Crash Data are collected. These reports describe crash involvement and are filled out by state and local police officials. Reported crash data in the Netherlands are administered by the Transport Research Centre (AVV). These data are based on reports of accidents, which are completed by police officials. These data represent virtually all fatal accidents, some 60% of all serious injury accidents, 40% of minor injury accidents and less than 10% property damage only accidents. The Central Bureau for Statistics uses these data to publish the official annual road safety statistics.

## 5.3 Compliance Reviews ('Bedrijfscontroles')

A compliance review is an on-site examination of a motor carrier's records and operations. In the United States compliance reviews are held by FMCSA-safety-investigators and their state counterparts. These control for drugs and alcohol, licensing, insurance, qualifications of drivers, driving of motor vehicles, roadworthiness and vehicle fitness, hours of service, inspection, repair, maintenance and transportation of hazardous materials. The number of crashes within the last twelve months is enclosed in the compliance review as well. The numbers of violations occurring at compliance reviews in the United States in 2000 are listed in Table 16. Data on the total number of motor carriers for 2000 were not available, data for the total number of active interstate motor carriers were available from MCMIS for 1999 (see paragraph 3.2).

**Table 16 Compliance Review Activity-Violation Summary**

| 2000 | Number | Percent |
|---|---|---|
| Number of inspections | 12624 | 100.0% |
| Reviews without violations | 403 | 3.2% |
| Reviews with violations | 12221 | 96.8% |
| Acute violations [1] | 2027 | |
| Critical violations [1] | 6860 | |
| Other violations [1] | 12095 | |
| Total violations | 20982 | |
| Average number of violations per inspection | | 1.66 |

Source: A & I online, (http://ai.volpe.dot.gov/MCSPA.asp)

[1] Number may exceed total of violations, since one review can register more than one violation.

In the Netherlands, similar compliance reviews are performed by the IVW. These reviews or inspections focus on driving and working hours, law of goods transport by road and other traffic related regulations and associated offences. The number of inspections and violations in 2000 are given in Table 17.

**Table 17 Compliance reviews performed by the IVW in 2000**

| 2000 | | Bus operators | Truck operators |
|---|---|---|---|
| Number of inspections | | 117 | 655 |
| Violations | 'Arbeidstijdenbesluit' | 814 | 36096 |
| | 'Wet goederenvervoer over de weg'[1] | 0 | 495 |
| | 'Overige overtredingen' | 0 | 11 |
| Total violations | | 814 | 36602 |
| Average number of violations per inspection [2] | | 7 | 55.9 |

Source: 2000 Een bewogen jaar, IVW 2001

[1] For the mode bus, this is a violation against the 'Wet en Besluit Personenvervoer', the Law on Passenger Transport.

[2] More than one violation per inspection possible

Most of the violations of truck operators (98%) were against the law 'Regulating driving and working times'. From the 36096 violations, 3205 were violations against the maximum driving time, 2270 against consecutive maximum driving time and 2594 against minimum rest time.

## 5.4 Closed Enforcement Case Data

Closed Enforcement Case Data result from major violations discovered during compliance reviews, and are tracked by the FMCSA from initiation through settlement. Closed enforcement case history may show a pattern of violations indicating a carrier management's lack of commitment to safety.

In the Netherlands the compliance reviews are analyzed and followed up by the IVW.

## 5.5 Roadside Inspections ('Wegcontroles')

The roadside inspections are performed by inspectors from the Motor Carrier Safety Assistance Program. Violations are administered and serious violations result in vehicles being declared unfit for use on public roads (vehicle-out-of-service) or drivers are not permitted to continue driving. In 1998 in the United States 2.145.609 roadside inspections were conducted. 405.727 vehicles were taken out of service and 169.881 drivers were not allowed to drive on (MCMIS).

The IVW is not responsible for the inspection of the technical state of a vehicle. The Dutch police have this responsibility. In the US, the FMCSA controls the technical state of vehicles.

Table 18 indicates the number of roadside inspections in the year 2000, performed by the IVW.

**Table 18 Roadside inspections excluding hazardous materials performed by the IVW in 2000**

| 2000 | | Bus | Trucks |
|---|---|---|---|
| Violations | | | |
| | 'Arbeidstijdenbesluit' | 165 | 3711 |
| | 'Wet goederenvervoer over de weg'[1] | 165 | 1122 |
| | 'Wegenverkeerswet' | 0 | 4675 |
| | 'Overige overtredingen' | 69 | 1294 |
| Total violations | | 399 | 10802 |
| Number of inspections | | 1501 | 21149 |
| Share of inspections with violations[2] | | 19.1% | 22.7% |

Source: 2000 Een bewogen jaar, IVW 2001
[1] In case of the bus, this is a violation against the 'Wet en Besluit Personenvervoer'.
[2] Possibly more than one violation per inspection

Included in the number of truck inspection are foreign trucks.

The number of roadside inspections is much higher in the US. Comparing the number of inspections with the number of trucks, this will lead to a 16% probability of being inspected in the Netherlands and 28% probability in the United States per year, when the inspections could be assumed independent. The number of inspections per million domestic truck kilometers is 5.5 in The Netherlands and 6.8 in the US.

Inspections of transportation of hazardous materials are also conducted by the IVW. Table 19 gives an indication of the inspections in 1999 and 2000 in the Netherlands.

**Table 19 Roadside inspections of hazardous materials held by the IVW in 1999 and 2000**

| Inspections for hazardous materials | 1999 | 2000 |
|---|---|---|
| Total violations | 1543 | 1050 |
| Number of inspections | 2195 | 2287 |
| Percentage violations [1] | 30.6% | 25.5% |

Source: 2000 Een bewogen jaar, IVW 2001
[1] more than one violation per inspection possible

Although the transport of hazardous materials is far more dangerous, the proportion of violations is higher than for non-hazardous materials. The number of inspections is significantly lower.

## 5.6 Motor Carrier Census Data

The identification, the size, and the operations of a company are reported in a database. These data are updated by the FMCSA during compliance reviews, during commercial vehicle registration and upon request of the motor carrier.

For the Netherlands this type of data is being collected by the IVW. For hire and reward firms there are NIWO identifiers and for own account operators there are SIEV identifiers. The vehicle licence numbers are registered at the Vehicle Technology and Information Centre (RDW) of the Ministry of Transport.

# 6. Summary and conclusions from Part I

## 6.1 Summary

In this Part I, a number of **differences** between the United States and the Netherlands have been pointed out, which can have important consequences for road traffic safety:

*Demographic, socio-economic, traffic network:*

- The Netherlands is much more densely populated and has an older population.
- The United States appear to have more motor carrier firms and more trucks and more passenger cars (related to the population) than the Netherlands.
- The Netherlands has a very dense road network. Especially the western part of the country has large traffic volumes. The United States, with its vast territory, has a lower network density, although there are big metropolitan areas with dense and heavily used networks.
- Unlike the American trucks, the Dutch trucks are frequently operated outside the home country. Conversely, there are also many non-Dutch trucks on the Dutch roads.
- The number of road traffic fatalities per person is higher in the United States, and so is the fatality rate in accidents involving trucks and buses. Data on number of injuries and property damage only accidents are hard to compare, because of insufficient registration and differences in definitions.

*Policy and regulations:*

- The minimum age for driving a commercial motor vehicle is 21 in the US and 18 in the Netherlands.
- The speed limits for trucks and buses in the US are generally higher than in the Netherlands.
- Unlike the US, the Netherlands has a minimum rest-time for bus and truck drivers.

*Practice:*

- The IVW is not responsible for inspecting the technical state of the vehicle, this is done by the police only; this is part of the FMCSA & State inspections in the US.
- The FMCSA & States carry out considerably more roadside inspections than the IVW (also when related to population or number of motor carrier vehicles).

Many **similarities** between the United States and the Netherlands could be mentioned here. Both are affluent western countries, where road transport is the dominant mode for both passenger and goods transport. Some not so widely known similarities with regards to the transport sector are the following.

*Demographic, socio-economic, traffic network:*

- The proportions of people working in the road transport sector are rather similar.
- It was expected that the average size of a US motor carrier firm would be considerably larger than for a Dutch motor carrier firm. However, no evidence for this was found; some of the evidence indicates this might even be the other way around.

*Policy and regulations:*

- Both countries have set quantified goals for road safety improvements in terms of decreases in the number of fatalities and injuries.
- Motor carriers require specific permits.
- Both countries have enforced maximum alcohol limits.
- Both countries have maximum driving time limits for vehicle drivers.

*Practice:*

- Both countries have traffic inspectorates carrying out both on-site compliance reviews (including follow-ups) and roadside inspections.
- The FMCSA carries out a comparable number of on-site compliance reviews as does the IVW (when related to population or number of motor carrier vehicles).

SafeStat uses information from:

- Reported accident statistics
- Compliance reviews
- Closed enforcement case data
- Roadside inspections
- Motor carrier census data.

All these types of information are in principle also available in The Netherlands

## 6.2 Conclusions

In this section we come back to the specific questions of chapter 2 and try to answer these in turn.

1. Are there differences in the road traffic accident rates and in the factors that influence road traffic safety that preclude an implementation of American tools like SafeStat in the Netherlands?

There are many differences in accident rates and influencing factors (see above, e.g. population density and road density) which make it impossible to transfer values (e.g. monetary values for fatalities), rates (e.g. accident rates, percentage distributions for reasons for accidents) or coefficient values for specific functions from the US to the Netherlands. However, we see no reason why a system integrating information from accident statistics, various inspections (e.g. compliance reviews, roadside inspections) and motor carrier statistics, such as SafeStat could not be implemented in the Netherlands.

2. Are there differences in the legal and administrative framework that preclude an implementation of American tools like SafeStat in the Netherlands?

The legal and administrative setting in the US is clearly different from that in the Netherlands (see above, e.g. driving times, recording devices). Because of this, a transfer of values, rates, percentage distributions or coefficient values for specific functions from the US to the Netherlands is not possible. On the other hand, the differences in the legal and administrative frameworks are not such that a SafeStat-like system integrating information from accident statistics, compliance reviews, roadside inspections and motor carrier statistics, could not be implemented in the Netherlands.

3. Are there differences in the work that the inspection agencies (FMCSA and IVW) carry out that preclude an implementation of American tools like SafeStat in the Netherlands?

The activities carried out by the American inspection agencies are clearly not the same as those of the IVW (e.g. unlike the FMCSA, the IVW is not responsible for inspecting the technical condition of the vehicle). This too makes it impossible to transfer values, rates or coefficient values for specific functions from the US to the Netherlands. But again this does not provide arguments for concluding that a system integrating information from accident statistics, various inspections and motor carrier statistics, would not be possible for the Netherlands.

4. If the above questions can be answered 'no', are the types of data that Safestat and related instruments require available in the Netherlands?

In principle: yes, the types of data are available. The details will be investigated in the third report in this project. In developing a proposal for implementation in the Netherlands, we should take into account that the number of observations in the Dutch inspection data (roadside inspections and compliance reviews, excluding inspections by the police) is considerably smaller than in the US. Some distinctions made in Safestat, may not be possible in a Dutch tool, because there may not be enough data to support the distinction. Furthermore, not only the number of inspections is much smaller in the Netherlands, but also the number of (fatal) accidents. One of the activities to be carried out in further phases of this project is to determine whether the databases of the Netherlands are large enough to be used to produce inputs for instruments like SafeStat and related American tools and to yield significant estimates of coefficient values to be used within such instruments.

5. If SafeStat and related instruments can be implemented in the Netherlands, are there specific differences between both countries, which need to be taken into account in the development of tools for the Netherlands?

An important difference is that IVW is not responsible for inspecting the technical state of the vehicles. Indicators for the impact of this on road traffic can be included in a Dutch instrument, but should not be included in a calculation of the effects of the activities of the IVW. Furthermore, in developing a Dutch tool, one should take into account that a large fraction of kilometers driven with Dutch trucks occurs outside the Netherlands, whereas foreign trucks are important user groups on Dutch roads.

Furthermore we have found that the fatality rate in road traffic is higher in the US than in the Netherlands. It is therefore likely that there is less scope for reducing the fatality rate by law enforcement activities in the Netherlands than in the US. Conceivably, further reductions in the fatality rates in the Netherlands are only possible at a societal cost which exceeds the present US reduction cost (assuming a reduction cost function which increases with increasing fatality rates).

The key question to be answered in Part I was:

*Can US instruments for giving safety ratings to carriers and for evaluation of road traffic safety policy be used in the Netherlands both for selecting unsafe carriers and for monitoring the effects of the activities of Transport Inspectorate Netherlands, or are there differences between both countries, which preclude such implementation?*

Our answer is affirmative, in the sense that the general principle of integrating information from accident statistics, inspections and motor carrier statistics and other general concepts from the methodology used in SafeStat and related US instruments can be implemented in the Netherlands as well. Whether the distinctions in SafeStat between four different safety evaluation areas and the various indicators developed within these areas can be used as well, is discussed in Part III of this report. Specific values, rates and functions from the American tools can not be directly transferred to the Netherlands. For these, estimation on Dutch data is required or expert judgement needs to be used to develop a working version which might be extended at a later stage.

# PART II. Description of SafeStat and related tools in the United States

# 7. Introduction to Part II

The Federal Motor Carrier Safety Administration (FMCSA) in the United States uses on-site compliance reviews (CR) and vehicle/driver roadside inspections as its principal means of ensuring that motor carriers operate safely and in compliance with the Federal Motor Carrier Safety Regulations and applicable Hazardous Materials Regulations.

One of the objectives of the FMCSA is to reduce commercial motor carrier crashes. In order to achieve this, the FMCSA, together with the Volpe National Transportation Systems Center have developed some useful tools to prioritize carriers for inspection and to measure the effectiveness of the National programs.

This Part II gives a description of these tools. SafeStat (Motor Carrier Safety Status Measurement System) is the most important of these. First however, a description is given of the Performance and Registration Information Systems Management (PRISM) program within which SafeStat was developed.

Not only the SafeStat tool will be discussed, also other tools developed in the United States will be discussed briefly. These are:

- The Inspection Selection System (ISS);
- The Compliance Review (CR) Impact Assessment Model and
- The Safe-miles Model.

Finally, this Part II will discuss the effect of enforcement activities on traffic safety in the United States.

# 8. Performance and Registration Information Systems Management (PRISM)

## 8.1 Background

Performance and Registration Information Systems Management (PRISM) is a cooperative Federal/State programme (a set of policies, not a computer program) that can identify specific motor carriers and systematically monitor their safety performance. The PRISM program started as a pilot in five States over a period of 4 years, ending in 1997. The results of the PRISM study proved conclusively that a link could be established between Federal and State information systems, and that the Commercial Motor Vehicle (CMV) registration process could serve as a powerful enforcement tool in both Federal and State motor carrier safety programs. In 1998, US Congress authorized additional funding for a 6 year period and directed the Federal Highway Administration to implement the PRISM program nationwide. Currently, there are 18 States participating in the PRISM program; FMCSA expects 4 to 5 new States to join the PRISM programme annually.

## 8.2 Objective

The objectives of the PRISM progamme are firstly to determine the safety fitness of motor carriers prior to issuing license plates and secondly to make unsafe motor carriers improve their safety performance through a performance-based improvement process, and, when necessary, applying sanctions.

## 8.3 How it works

The PRISM program is based on two major processes - the Commercial Motor Vehicle Registration Process and the Motor Carrier Safety Improvement Process (MCSIP). These processes help to monitor motor carriers and hold them responsible for the safe operation of their vehicles and to identify and improve the performance of unsafe carriers.

*The Commercial Motor Vehicle Registration Process*
The basis for the PRISM project is the International Registration Plan (IRP). The IRP is an agreement among the States and Canadian Provinces for uniformly registering CMV's engaged in interstate transport. Vehicles registered under the IRP receive a license plate issued by the home State bearing the word "apportioned" and a

registration card listing the jurisdictions in which the vehicle is registered to operate. Carrier safety is a requirement for obtaining (and keeping) an IRP license plate. PRISM ensures that all carriers engaged in interstate commerce are uniquely identified by a USDOT number when they register their vehicles, and that the safety fitness of each carrier is checked prior to issuing vehicle registrations.

Thus, State registration agencies may deny the registration of vehicles from an unfit carrier, or suspend or revoke existing State vehicle registrations.

*Motor Carrier Safety Improvement Process (MCSIP)*
MCSIP is the system by which the performance of potentially unsafe carriers is monitored and improved. The system improves the safety performance of high-risk carriers (i.e. carriers with poor safety performance) through more accurate identification, performance monitoring, and treatment. For carriers within the MCSIP, performance is reviewed more frequently than for carriers outside the MCISP and the resulting safety data is uploaded to a national motor carrier safety database called the Motor Carrier Management Information System (MCMIS). Carriers are assigned a preliminary safety indicator using the Motor Carrier Safety Status (SafeStat) Measurement System. SafeStat uses highway safety and compliance data from MCMIS to calculate the safety indicator. Depending on their SafeStat value, unsafe carriers are given either a Warning Letter, or are subjected to a compliance review. Carriers that improve their safety performance after a 6-month monitoring period may exit the MCSIP process. If performance does not improve, carriers face progressively more stringent treatment, culminating in a Federal Operations Out-of-Service Order.

# 9. Motor Carrier Safety Status (SafeStat) Measurement System

## 9.1 Background

The Motor Carrier Safety Status Measurement System (SafeStat) was developed as a tool in the PRISM project to assess the safety status of carriers. SafeStat is an automated, data-driven analysis system designed to incorporate current on-road safety performance information on all carriers with on-site compliance review and enforcement history information, when available, in order to measure relative motor carrier safety fitness. Since 1995 SafeStat has been implemented in approximately six-month cycles to identify carriers for PRISM and since 1997 it has been implemented nationally to prioritize motor carriers for on-site compliance reviews (CRs).

## 9.2 Objective

The objective of SafeStat is to use a single methodology of measuring motor carrier safety fitness and the definition of a comprehensive process to improve the safety status of unsafe carriers. The system allows the FMCSA to continuously quantify and monitor changes in the safety status of motor carriers, especially unsafe carriers.

The primary use of SafeStat is to identify and prioritize carriers for FMCSA and state safety improvement and enforcement programs. Currently, SafeStat plays an important role in determining motor carrier safety fitness in several FMCSA/state programs including the Performance & Registration Information Systems Management (PRISM), National Compliance Review (CR) Prioritization, and the roadside Inspection Selection System (ISS).

## 9.3 How it works

### 9.3.1 In general

SafeStat basically measures the overall relative safety of motor carriers. This overall SafeStat score is based on four, so called Safety Evaluation Areas (SEAs)(Figure 2), which are:

- Accident

- Driver
- Vehicle
- Safety Management

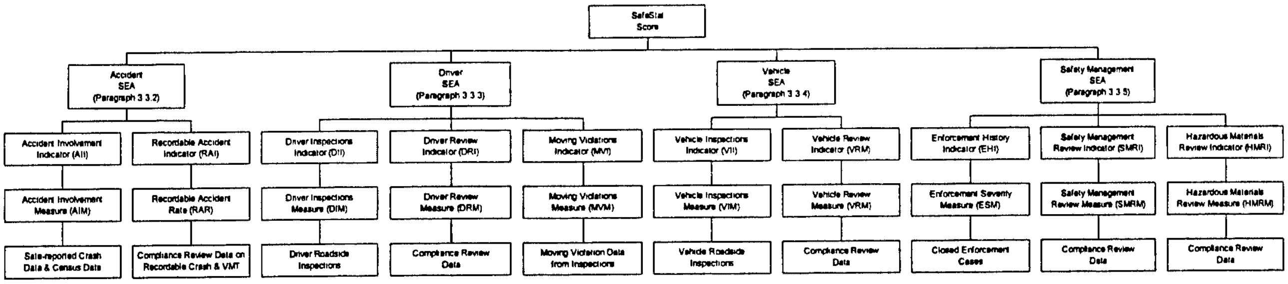



**Figure 2 SafeStat computational structure**

The relative risk for each carrier of having future crashes is calculated in all four areas, based on the carriers' past safety performance in the specific area. This way the strengths and weaknesses of each carrier can be assessed and the FMCSA can focus their safety improvement efforts. Because the primary purpose of SafeStat is to identify carriers for safety improvement programs, only the worst performing carriers (being in the worst quartile in two or more SEAs) will receive an overall SafeStat score. As it is a relative score, it represents the overall safety status of a carrier in relation to its peers. This way they can be identified and monitored in MCSIP and prioritized for compliance reviews.

SafeStat calculates the SEA scores and the overall SafeStat score, using data from the following sources:

- **State-reported commercial vehicle crash data** – data from crash reports filled out by police officials according to national standards.
- **Compliance Reviews** – information from on-site inspections regarding the compliance with Federal Motor Carrier Safety Regulations (FMCSR) and in case relevant, compliance with Hazardous Material Regulations (HMR).
- **Closed Enforcement Case Data** – history of violations, discovered during compliance reviews.
- **Roadside Inspections** – data from inspections on commercial motor vehicles and drivers, regarding FMCSR and HMR violations, out-of-service (OOS) orders and OOS order violations.
- **Motor Carrier Census Data** – information regarding identification, size, operations, etc. stored in the Motor Carrier Management Information System (MCMIS).

To calculate the different SEA values, SafeStat normalizes safety-event data to measure safety compliance and performance of individual carriers. It uses carrier-descriptive data to normalize a carrier's safety-event data. This means that rates are calculated, which can be compared between the carriers, for instance the crash rate that is calculated by dividing the number of crashes by the amount of vehicle-miles traveled.

In calculating these measures, SafeStat applies time weighting on the safety-event data. Time-weighting stresses the outcome of more recent safety events, which are more relevant to current safety status, and phases out safety-event data as they become older and less likely to reflect current safety status. Carriers stay motivated to improve their safety status, because the adverse safety events in the past age to zero.

SafeStat then ranks each measure, like the crash rate, on a percentile scale and this results in an indicator for each carrier. At this stage, rules are applied to address problems regarding insufficient data. This way the rating of a specific measure is based on sufficient data ensuring that the corresponding indicator is statistically meaningful.

The final step in generating a SEA value is to combine the indicators within each SEA. The SEA value is again a percentile rank that is given to carriers with sufficient data relevant for that SEA. Only the worst performing carriers (being in the worst quartile in two or more SEAs) will receive an overall SafeStat score.

The SafeStat score is being calculated by the sum of the SEAs values for which the carrier belongs to the worst quartile (SEA value of 75 or higher) of the specific SEA. The Accident SEA value is weighted twice, while the Driver SEA value is weighted one and a half time and both the Vehicle SEA and the Safety Management are weighted only once. These weights have been the result of the fact that the accident history and driver factors have emerged as the SEAs most associated with future crash risk. Then, carriers with a SafeStat score are ranked in descending order by their score and assigned to a category. The next table displays the categories distinguished.

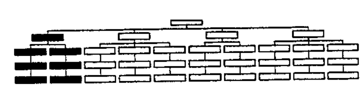
**Table 20 SafeStat categories for carriers with a SafeStat score**

| Category | SafeStat score range | Includes SEA values of 75 or higher |
|---|---|---|
| A | ≥350 to ≤550 | All 4 SEAs<br>3 SEAs that result in a Weighted Score of 350 or more |
| B | ≥225 to <350 | 3 SEAs that result in a Weighted Score of less than 350<br>2 SEAs that result in a Weighted Score of 225 or more |
| C | ≥150 to <225 | 2 SEAs that result in a Weighted Score of less than 225 |

For carriers, which do not receive a SafeStat score but were ranked deficient in one SEA, SafeStat also assigns a category. These are D to G for carriers that are deficient in only one SEA. These are, respectively, the Accident SEA, the Driver SEA, the Vehicle SEA or the Safety Management SEA. These last four categories are used to prioritize carriers for roadside inspections in the Inspection Selection System (ISS).

A detailed description of the SafeStat Algorithm can be found in Appendix A.

### 9.3.2 Accident SEA



In the Accident Safety Evaluation Area, the safety performance of a carrier is represented by the involvement in crashes relative to its peers. The Accident SEA Value is based on two indicators, the Accident Involvement Indicator (AII) and the Recordable Accident Indicator (RAI).

The Accident Involvement Indicator (AII) uses measures derived from state-reported crash data normalized by fleet data from the Motor Carrier Census. From the state-reported crash data, the date of the crash, injuries, fatalities and released Hazardous

Material (HM) are used to calculate the AII. The Motor Carrier Census Data supplies the number of owned and term-leased power units (trucks, HM tank trucks, tractors, motor coaches, and school buses) contained in the Census data.

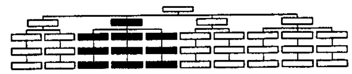
Only crashes that have occurred within the last 30 months are taken into account and are time weighted to give more relevance to recent crashes than to older crashes. Also, weights are applied to individual crashes based upon the severity of the consequences (i.e., vehicle towed, injury, fatality, and release of hazardous material). The weighted crash information is normalized by the number of vehicles to obtain the Accident Involvement Measure. Carriers with similar numbers of state-reported crashes are grouped, compared to one another by their Accident Involvement Measures, and ranked on a percentile basis to obtain the AII. A carrier must have two or more crashes to receive a deficient AII, i.e., 75 or higher.

The Recordable Accident Indicator (RAI) uses measures based on recordable crash and annual vehicle-miles traveled (VMT) data gathered at the most recent compliance review. The compliance review provides the date of the review, the number of recordable crashes within 12 months prior to the review and the total number of vehicle miles traveled (VMT) by a carrier within 12 months prior to the review.

Only carriers that have had compliance reviews within the past 12 months are taken into account. SafeStat takes the number of recordable crashes and normalizes it by the VMT to obtain a Recordable Accident Rate. Carriers with similar numbers of recordable crashes are grouped, compared to one another by their crash rates, and ranked on a percentile basis to obtain the RAI.

Based on the availability of most recent compliance review data and state-reported crash data, several possible cases exist in determining the Accident SEA value. SafeStat determines which case exists for each carrier and calculates the Accident SEA value accordingly.

### 9.3.3 Driver SEA



The Driver Safety Evaluation Area focuses on a carrier's driver-related safety performance and compliance. The Driver SEA value is based on three indicators, namely the Driver Inspections Indicator (DII), the Driver Review Indicator (DRI) and the Moving Violations Indicator (MVI).

The Driver Inspections Indicator (DII) is based on driver roadside inspection data. SafeStat uses only those roadside inspections that have been performed within the last 30 months and relate to the driver. From the driver roadside inspection data, the number of driver out-of-service (OOS) violations, number of drivers placed OOS, number of driver inspections and number of violations of OOS orders (both vehicle and driver) are used.

SafeStat calculates the DII for all carriers that have had a minimum of 3 driver inspections. Each inspection is weighted by its age and the number of driver OOS violations found. The weighted driver OOS result is normalized by the number of driver inspections to obtain the Driver Inspections Measure (DIM). The DIM is adjusted upward in instances where the driver was found violating OOS orders. Carriers with similar numbers of driver inspections are assigned to one of four groups. Within each group, they are ranked by their DIM. SafeStat assigns a DII percentile number based on that rank.

The Driver Review Indicator (DRI) is based on the violations of driver-related acute and critical regulations discovered during a compliance review. Only, data from compliance reviews performed within the last 18 months are included. The number and severity of violations of driver-related acute/critical regulations cited at a carrier's most recent compliance review is quantified into the Driver Review Measure (DRM). All of the carriers are ranked based on their DRMs and are then assigned a DRI percentile. Only carriers that have at least one violation of an acute and a critical regulation receive a DRI percentile.

The Moving Violations Indicator (MVI) is based on the following serious moving violations, which are recorded in conjunction with roadside inspections within the last 30 months:

- Failure to obey traffic control device;
- Following too closely;
- Improper lane change;
- Improper passing;
- Reckless driving;
- Speeding;
- Improper turn;
- Failure to yield right of way;
- Use or possession of drugs;
- Use or possession of alcohol.

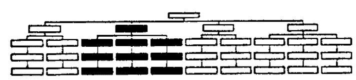
At least 3 serious moving violations are necessary for a carrier to receive a MVI. From the roadside inspections, the number of Serious Moving Violations and the date of

Serious Moving Violation are used. Also, the number of drivers from the Motor Carrier Census Data is being used.

Each serious moving violation is weighted by its age and then normalized by the number of drivers to obtain the Moving Violations Measure (MVM). Carriers with similar numbers of violations are grouped, ranked by their MVM rates and assigned MVI percentile number.

SafeStat uses the Driver Inspections Indicator (DII) and the Driver Review Indicator (DRI) and the Moving Violations Indicator (MVI) with their associated indicator weights to calculate the Driver SEA Value.

### 9.3.4 Vehicle SEA



The Vehicle SEA focuses on a carrier's vehicle-related safety performance and compliance. The Vehicle SEA Value is based on the Vehicle Inspections Indicator (VII) and the Vehicle Review Indicator (VRI).

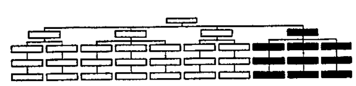
The Vehicle Inspections Indicator (VII) is based on vehicle roadside OOS inspection violations. Only roadside inspections that have been performed within the last 30 months and relate to vehicles, are considered. From roadside inspections, the number of vehicle OOS violations, the number of vehicles placed OOS and the number of vehicle inspections are used.

SafeStat calculates the VII for all carriers that have had a minimum of 3 vehicle inspections. Each inspection is weighted by its age and the number of vehicle OOS violations and then normalized by the number of vehicle inspections to obtain the Vehicle Inspections Measure (VIM). Carriers with similar numbers of vehicle inspections are assigned to one of three groups. Within each group they are ranked by their VIMs and assigned a VII percentile number based on its rank. A carrier must have 3 or more vehicle OOS inspections to have the potential to receive a deficient VII.

The Vehicle Review Indicator (VRI) is based on the vehicle-related violations of acute and critical regulations discovered during compliance reviews. Only results from compliance reviews performed within the last 18 months are considered. The number and severity of violations of vehicle-related acute/critical regulations cited at a carrier's most recent compliance review is quantified into the Vehicle Review Measure (VRM). The carriers are ranked based on their VRMs and assigned a VRI percentile number. Only carriers with at least one violation of acute and/or critical regulations receive a VRI.

SafeStat uses the Vehicle Inspections Indicator (VII) and the Vehicle Review Indicator (VRI) with their associated indicator weights to calculate the Vehicle SEA Value.

## 9.3.5 Safety Management SEA



The Safety Management SEA Value reflects the carrier's safety management attitude relative to its peers. The Safety Management SEA Value is based on the Enforcement History Indicator (EHI), the Hazardous Material Review Indicator (HMRI), and the Safety Management Review Indicator (SMRI).

The Enforcement History Indicator (EHI) is based on the results of violations cited in closed enforcement cases. An enforcement case is the result of one or more serious violations discovered by a safety investigator usually during a compliance review. A carrier's closed enforcement case history may contain a pattern of violations that could indicate a serious lack of commitment to safety on the part of the carrier's management. The purpose of this indicator is to measure the historical pattern of safety enforcement. The EHI is calculated for each carrier that has had a closed enforcement case within the last 6 years. For each such carrier, SafeStat accounts for all of its prior closed enforcement cases, which are time and severity weighted, to obtain the Enforcement Severity Measure (ESM). All carriers with ESMs are ranked and assigned an EHI percentile number.

The Hazardous Material Review Indicator (HMRI) uses violations of hazardous material-related acute and critical regulations that were discovered during a compliance review. Only data from compliance reviews performed within the last 18 months are taken into account. The number and severity of violations of hazardous material-related acute and critical regulations cited at a carriers' most recent compliance review is quantified to obtain an HM Review Measure (HMRM). The carriers are ranked based on the HMRMs and assigned a HMRI percentile number. Each carrier should have had at least 1 violation of acute and critical regulations.

The Safety Management Review Indicator (SMRI) uses violations of safety management-related acute and critical regulations that were discovered during a compliance review. Only data from compliance reviews performed within the last 18 months are taken into account. The number and severity of violations of safety management-related acute and critical regulations cited at a carrier's most recent compliance review is quantified to obtain the Safety Management Review Measure (SMRM). The carriers are ranked based on the SMRMs and assigned a SMRI percentile number. Each carrier should have had at least 1 violation of acute and critical regulations.

# 10. Inspection Selection System (ISS)

## 10.1 Background

The Inspection Selection System (ISS) is a decision-aid tool for commercial vehicle roadside driver/vehicle safety inspections, which guides safety inspectors in selecting vehicles for inspection. The original ISS (ISS-1) was first introduced in 1995. ISS-1 was based on a number of factors but primarily focused on a carrier's history of out-of-service violations. ISS-2, introduced in 1999, was based on the more comprehensive SafeStat carrier prioritization algorithm, which broadens the criteria for defining a high-risk carrier, but primarily focuses on the history of crashes. ISS-1 and ISS-2 are highly correlated. According to our information, ISS-2 is currently fully operational and the ISS-1 data update ended.

## 10.2 Objective

The objective of the ISS is to target carriers for roadside inspection with prior poor safety performance and those that have insufficient safety data.

## 10.3 How it works

ISS provides an easy means of selecting vehicles for roadside inspection based on SafeStat indicators, the carriers' history of past inspections and whether or not the carrier is in the PRISM MCSIP program. The ISS only makes recommendations. The inspector always makes the final decision. By entering the carriers' DOT number, ICC number or carrier legal name into the ISS computer programme, the ISS returns one of the following recommendations:

- Inspect (inspection value 75 – 100)
- Optional (inspection value 50 – 74)
- Pass (inspection value 1 – 49)

The inspection value is based on data analysis of the motor carrier's safety performance record using the information in the National MCMIS. The algorithm for assigning the inspection value is based on SafeStat. Using the SafeStat SEA scores, carriers are grouped and for each carrier a total score is derived from the SEA scores. The carriers are then ranked based on their total score and assigned percentile ranks, which become the ISS inspection value.
In the case of motor carriers for which there is little information, the ISS determines the inspection value by weighing the carrier size and number of past inspections. This is called the insufficient data algorithm. The idea behind it is to encourage inspections

when there is little carrier history or past inspections. As the inspection data increases, the inspection value decreases and eventually the carrier will move into SafeStat and be monitored via safety performance.

A detailed description of the safety algorithm and the insufficient data algorithm can be found in Appendix B.

# 11. Compliance Review Impact Assessment Model (CRIAM)

## 11.1 Background

Compliance Reviews (CRs) are on-site examinations of motor carrier's records and operations to determine whether carriers meet the FMCSA safety fitness standard. It is intended that through education, heightened safety regulation awareness, and enforcement effects of the CR, motor carriers will improve the safety of their commercial vehicle operations and, ultimately, reduce their involvement in crashes. The CR Impact Assessment Model (CRIAM) was developed to determine the effectiveness of the CR program. It was completed in 1998 and based on 1996 data.

## 11.2 Objective

The objective of the Compliance Review Impact Assessment Model is to estimate the direct effects of performing CRs by determining the reduction in crashes and resulting cost savings for carriers receiving CRs. The direct effects are represented in terms of crashes and costs avoided.

## 11.3 How it works

The model is based on the individual and cumulative "before and after" changes in safety performance of carriers that received CRs. The approach taken by the model is to analyze changes in a motor carriers' safety performance in a time period after an on-site compliance review in comparison to its safety performance prior to that review. This analytic model shows the direct impact of the performance of compliance reviews on carrier safety. It does not assess the deterrent effects of CRs. The model uses data collected during CRs that include the carrier's recordable crashes and vehicle miles traveled (VMT) during the 12 months preceding the review. The model measures the collective changes in individual carrier crash rates between two successive reviews one year or more apart, capturing the effect of the first review.

Because CRIAM determines the change in crash rates (crashes per Vehicle Miles Traveled (VMT)) from before to after the CRs, it required not only pre-CR crash rates but also crash rates after the CRs. Consequently, the model only considers carriers with two CRs. The earlier (or initial) CR provides the pre-CR crash rate data and the subsequent (or follow-up) CR provides the post-CR crash rate data.

First, carriers with two or more CRs that were between 12 and 24 months apart were identified. Before (from initial CR) and after (from follow-up CR) crash rates were obtained (Recordable Crashes per million VMT) and changes in the crash rates were calculated.

The next step was to estimate the total number of crashes avoided that were attributed to all CRs. This was done by applying the average reduction in crash rates to a baseline crash rate (the average crash rate for all carriers receiving CRs). This provided a crash-avoided rate per million VMT. It is believed that, although the effect of the CR on crash reduction diminishes over time, it is still present after one year. The model assumed CRs to affect crash rates for three years, declining in influence each year. The model assumes diminishing impact of two thirds of the first year impact in the second year and one third of the first year impact in the third year. In order to reflect the full multi year effects, the exposure of the reviewed carriers was estimated in VMT for each of the three years following the CR.

Finally, the benefits were calculated by applying an average cost per crash to the number of avoided crashes.

## 11.4 Recognized limitations and recommendations

Several limitations with this initial Compliance Review Impact Assessment Model have been recognized. These can be summarized as follows:

- The duration of the impact of a CR and the reduction of that impact over time were not empirically established.
- The subset of carriers who received two or more CRs may be different from the rest of the carriers who only received a single CR. Therefore it is not a representative sample.
- The model does not differentiate between impacts based on any characteristics of the carriers involved.
- There are clearly "events" other than the CR in the "before" and "after" time periods that may affect a carrier's safety performance (crash rate).

Based on these limitations and research into the effects of SafeStat prioritization on CRIAM and the CR Impact Assessment based on State-reported crashes, the following recommendations for improvement were made:

- A new effort in collecting crash rate information on a cross-sectional sample of carriers that have received CRs was proposed. These new data with periodic updates can provide a basis for annual measurements of CR programme effectiveness. These data also can be used in analyses to determine the influence of certain factors on the program's effectiveness.
- A control group of carriers, carriers with no recent CR, should be carefully matched to the study group, carriers with recent CRs. Using a control group will address several of the limitations of the initial model and will improve the accuracy of the model's results.
- The development of a detailed data collection and analysis plan is required.

## 11.5 Improved Compliance Review Impact Assessment Model

A number of the above recommendations to improve the compliance review impact assessment model (CRIAM) have been implemented recently. The main difference is that the analysis is no longer done by comparing two compliance reviews for the same carrier (a small and not representative sample), but by comparing survey data with compliance review data by carrier.

All motor carriers with a compliance review in 1998 (independent of whether the outcomes of the CR were satisfactory of unsatisfactory) were recontacted in a survey carried out in 1999. These interviews were done using a questionnaire form on paper, sent and to be returned by mail. The outcomes were analysed in 2000.

The response rate was very high (about 90%), which is probably due to the fact that the carriers got the impression that they were obliged to fill in the form. The questionnaire asked about the number of recordable crashes in 1999 and the total vehicle miles travelled in 1999. Early analysis showed an increase of about 20% in the crash rate compared to the earlier compliance review. The vehicle miles travelled from both sources were consistent. This unexpected result was attributed to the definition of a crash that the carriers had in mind when filling in the questionnaire: many included all insurance claims (including property damage only incidents) to determine the crash count, not just the recordable crashes that the state inspectors collect in the compliance review. The crash rates from second compliance reviews had to be used to determine an adjustment factor for the over-reporting . This adjustment factor was also used for the carriers that did not have a second compliance review. The adjusted average crash reduction rate using both sources was 10.2%.

This result has been used in the second generation CRIAM, which in other respects works in the same way as the first generation tool.

# 12. Safe-Miles Model and Intervention Model

## 12.1 Background of Safe-Miles

The States in the USA perform inspections of vehicles and drivers at fixed and mobile sites to ensure compliance with the Federal Motor Carrier Safety Regulations (FMCSRs), Hazardous Material Regulations (HMRs), and related state laws. Serious violations that are detected result in the vehicle/driver being placed out-of-service (OOS) until the deficiency is remedied.

The Safe-Miles model was developed to determine the effectiveness of the roadside inspection program. The name Safe-Miles given to the model refers to the safety benefit achieved through roadside inspections. These inspections serve to detect and correct out-of-service vehicle defects and drivers with problems, which if left undetected would have contributed to a crash with some positive probability. Subsequent travel by those vehicles and drivers is therefore converted from unsafe to safe miles. The model was completed in November 1997 and based on 1996 data.

## 12.2 Objective of Safe-Miles

The Safe-Miles model was developed to determine the effectiveness (in terms of decreasing the number of accidents and in monetary terms) of the roadside inspection program. Therefore, the objective is to estimate the crashes avoided and cost benefits resulting from detecting and correcting vehicle and driver OOS conditions.

## 12.3 How Safe-Miles works

The Safe-Miles Model is based on the belief that the roadside inspection program has both direct and deterrent effects. The direct effects are based on the corrections of out-of-service deficiencies (reactive). The deterrent effects are based on the safety improvements made by carriers due to their awareness of the program and consequences it can have on their operations (pro-active).

The effects are translated into number of miles converted to safe (Safe-Miles) and then the number of safe miles gives the expected number of crashes over Safe-Miles. The number of crashes avoided can be calculated and the final result is used to calculate the societal benefits of the avoided crashes. Benefits of direct and deterrent effects are then added to obtain the overall performance of the roadside inspection program.

*Direct effects*
The direct effects component of the model estimates the number of crashes avoided and the costs and benefits of detecting and correcting the vehicle and driver Out-Of-Service (OOS) conditions.

First, it is important to determine the number of vehicles placed Out-Of-Service for vehicle and for driver problems during a given time period. The length of time that the benefits from detecting and correcting vehicles/drivers defects will last into the future was determined. Three months was considered as a 'safe' post inspection period for vehicles (period during which a vehicle is exempt from additional inspections after a satisfactory inspection), while the post-inspection safe period for corrected driver out-of-service defects was two months.

Safe-Miles estimates the number of miles following an OOS inspection, during the three (vehicle) or two (driver) months period. By multiplying the number of OOS inspections with the number of miles following an OOS inspection, the number of miles converted to safe (Safe-Miles) can be determined.

After this, the expected number of crashes without direct effects over the miles converted to safe can be calculated. Based on 1994 data, the overall crash rate is set at 0.885 crashes per million miles.

Safe-Miles also requires determination of the percentage of crashes with OOS defects as contributing factors. Based on a study from the Oregon State University it was concluded that 4.6% of all commercial vehicle crashes had mechanical defects. The Volpe team estimated that 5.7% of the crashes had driver-contributing factors that could be identified during a roadside driver inspection. These estimates are rather conservative.

Finally, the number of avoided crashes can be calculated. By finding an average weighted cost per crash, the benefits in US dollars can be obtained of the avoided crashes due to direct results from the roadside inspections.

*Deterrent effects*
The deterrent effect of the roadside inspection program is the impact that the very existence of the program has upon managers of motor carriers and drivers of CMVs. The realization that annually approximately 2 million roadside inspections (1998) of motor vehicles are conducted nationwide has led to permanent changes in the attitude of motor carrier managers with respect to vehicle maintenance, inspection procedures and the qualifications and behavior of their drivers.

For the Safe-Miles Model, these effects are estimated by assuming that they are partially reflected in a motor carrier's awareness of the program as a function of the number of vehicle and/or driver inspections that the carrier has experienced.

First, carriers subjected to inspection exposure are identified. This implies carriers with more than 6 driver inspections and/or more than 40 vehicle inspections. Furthermore, the number of annual VMT is estimated.

Then, the decline in OOS rate by number of inspections is estimated. By multiplying these percentages with the annual VMT, the number of miles converted to safe is determined. Next, the percentage of crashes with OOS defects as contributing factors is calculated.

Finally, the number of avoided crashes can be calculated. By finding an average weighted cost per crash, the benefits in US dollars can be obtained of the avoided crashes due to direct results from the roadside inspections.

## 12.4 Recognized Limitations and Recommendations of Safe-Miles

Several limitations with the Safe-Miles Model have been recognized. These can be summarized as follows:

- Although there is some empirical evidence that three months is a reasonable time period to use for accumulating safe-miles, there is no such evidence for establishing a driver safe-miles period.
- The Model assumes that detected defects will be repaired.
- The Model assumes that 4.6 percent of all crashes have vehicle defects that contribute to crash causation. Better empirical determination of the causation factor may yield the finding that more safe-miles are accumulated and crashes avoided through defect detection at roadside inspections.
- The Model may understate the proportion of the inattention situations identified as contributing to the cause of the crashes that could be linked to hours-of-service violations identified at a roadside inspection.
- The Model does not account for benefits resulting from program awareness of those carriers with little or no exposure to inspections.

With a second-generation model, the Intervention Model, the researchers in the United States tried to address some of the limitations in the Safe-Miles Model. This model is described in the remainder of this chapter.

## 12.5 Background of the Intervention Model

The Intervention Model or Roadside Intervention Model (RIM) contains a number of improvements over Safe-Miles. These include:

- The Intervention Model evaluates the total out-of-service inspection results. The Intervention Model makes the assumption that observed deficiencies at the time of a roadside inspection can be converted into crash involvement probabilities based on the type and number of these deficiencies. The underlying assumption of the Intervention Model is that deficiencies found during out-of-service inspections vary in severity and, as a result, vary in their crash involvement probabilities. The Intervention Model requires crash involvement probabilities for the entire range of circumstances covered during an out-of-service inspection.
- The Intervention Model will base its crash probabilities on two factors. First, some estimates of the frequency that out-of-service conditions (single or multiple) occur

among truck vehicle miles. Second, the frequency that out-of-service conditions (single or multiple) occur in or contribute to a crash.

- It is hypothesized that the roadside inspection program has a broader deterrent impact than the evidence presented above suggests.

## 12.6 Objective of the Intervention Model

SafeMiles was only about the effects of roadside inspections; the intervention model adds traffic enforcement programme effectiveness (e.g. stopping vehicles for speeding, drunken drivers), including intra-state transport. It uses data for 1998/1999. The objective is to compute direct and indirect (deterrent) effects.

## 12.7 How the Intervention Model works

*Direct effect*

The basic assumption is that an intervention (e.g. stopping a vehicle and taking away a defect) will reduce the number of crashes. Data on crash causation is missing. Some research for FMCSA on this is underway and can be used for the intervention model later on. In the absence of data, the intervention model uses the consensus of experts on transport and safety. In a study by Cycla Corp, industry experts rated many violations into risk categories (1 to 5):

1. Violation is **potential single, immediate** factor leading to a crash;
2. Violation is **potential single, eventual** factor leading to a crash;
3. Violation is **potential contributing** factor leading to a crash;
4. Violation is **unlikely potential contributing** factor leading to a crash;
5. Violation has **little or no connection** to crashes.

For other violations, Volpe collected independent expert opinions. Now each of 900 violations have been assigned a risk profile (1 to 5 as above). Per risk category there is an estimate of the number of violations that corresponds to one crash avoided, ranging from 500 to 625,000.

For the direct effect of roadside inspections and traffic enforcement the above information and inspection data on corrected violations is used to calculate the number of crashes avoided. The outcomes are split into effects of the roadside inspections programme and of the traffic enforcement programme. The impact of multiple violations found during the same inspection is taken into account.

*Indirect or deterrent effects*

The indirect effects refer to the effects of the inspections in later periods. These are measured by comparing crash probabilities of the same carriers in year 1 and year 2, for carriers with sufficient data on inspections and which have improved over the period. The difference is attributed to the inspections and enforcement.

# 13. Effects of enforcement activities on the traffic safety in the United States

## 13.1 Compliance Review Impact Assessment Model (CRIAM)

Between April 1993 and June 1997, 1738 carriers that met the criteria of having two or more CRs within the specified time of 12 to 24 months were identified. These carriers had an overall crash rate of 0.750 crashes per million VMT, based on the initial CR, and a crash rate of 0.661, based on the follow-up CR, representing a 12% reduction in the crash rate. This 12% reduction was assumed to be valid for all carriers that received a CR in 1996.

Preliminary estimates from the Impact Assessment Model are 4,317 crashes avoided for the 8,111 carriers that received CRs in 1996. The average weighted crash cost was calculated to be $135,000. Applying this average cost to the 4,317 crashes avoided results in a benefit of approximately $580 million. In addition to the immense benefits of avoiding pain and suffering and the loss of life, this represents an average of over $71,000 cost savings per review.

The second generation CRIAM gives 1,083 crashes avoided in 1999, 46 lives saved and 742 injuries avoided. Benefits in subsequent years (indirect effects) could exist, would probably not be large and are not measured because there is no basis for measuring them.

## 13.2 Safe-Miles and Intervention Model

Using the initial version of the Safe-Miles model, a preliminary estimate (based on 1996 data) of the direct impact of the roadside inspection program was made. In that year, there were 437,478 vehicle out-of-service inspections and 161,530 driver out-of-service inspections. The duration of the effect of corrections to out-of-service conditions is estimated at 15,000 VMT for 3 months after a vehicle is placed out-of-service and 10,000 VMT for 2 months after a driver is placed out-of-service. Thus, 1996 vehicle out-of-service inspections are estimated to result in 6.53 billion "safe-miles" and driver out-of-service inspections in 1.61 billion "safe-miles".

Based on the general truck population average (1994) of 0.885 recordable truck crashes per million VMT, there would have been 5,800 recordable crashes for the "safe-miles" following vehicle inspections and 1,400 recordable crashes for the "safe-miles" following driver inspections. Therefore, the "safe-miles" generated by 1996 vehicle inspections resulted in 266 avoided crashes and the "safe-miles" generated by 1996 driver inspections resulted in 81 avoided crashes. The average weighted crash cost was then calculated to be $135,000. Applying this average cost to the 347 (266 + 81) crashes avoided results in an estimated benefit of $47 million due to the direct effects of the inspection program.

The deterrent component of the model was also calculated using 1996 data. The out-of-service rates and the decline in these rates due to the deterrent effect were used to determine the number of miles converted to "safe-miles" as a consequence of the deterrence. Using the same crash rates and percentage of crashes linked to driver and vehicle defects applied in the direct component of the model, the deterrent effect resulted in 163 crashes avoided as a result of vehicle inspections and 130 crashes avoided as a result of driver inspections. Again using the weighted cost of truck crashes, these 293 crashes avoided due to the deterrent effect were estimated to save $39 million on an annual basis.

Combined with the direct benefits, total 1996 program benefits from the roadside inspection program were estimated at $86 million.

In the Intervention Model, the number of crashes avoided (distinguishing direct versus indirect, roadside inspections versus traffic enforcement) is assigned to fatal, injured and towed away. The outcome is about 1,600 crashes avoided:

- Direct effect of roadside inspection program: 1,049 crashes avoided;
- Indirect effect of roadside inspection program: 44 crashes avoided;
- Direct effect of traffic enforcement program: 279 crashes avoided;
- Indirect effect of traffic enforcement program: 52 crashes avoided.

Using a fixed set of proportions of crash severity (3.6% fatal, 40.0% injury and 56.4% tow away) and the average number of fatalities (1.19) and injuries (1.26 or 1.60) for fatal or injury crashes, the number of crashes avoided is converted to lifes saved, etc. The outcome is almost 70 lives saved in total, of about 5,000 fatalities per year related to CMV crashes; this number is not just the truck drivers, but all fatalities in crashes involving trucks.

# 14. Summary and Conclusions Part II

## 14.1 General

In the United States a number of tools have been developed to monitor or assess developments in motor carrier safety. There are both tactical instruments which are used regularly (even daily) by operating units of the government institutions entrusted with improving traffic safety, and strategic instruments, which are used occasionally to monitor and assess the effectiveness of policy initiatives.

Tactical instruments are:

- SafeStat, developed by Volpe, is used particularly for identifying road haulage firms for on-site compliance reviews in the framework of PRISM (Performance and Registration Information Systems management). SafeStat calculates a safety score (or rather an unsafety score, since it's really a sort of probability of a crash) for individual road haulage and bus transport firms. Its main innovation and most attractive feature is the use of data from a variety of sources (including both crash statistics and information gathered at inspections) in an integrated manner.
- Inspection Selection System (ISS): the ISS was originally developed to prioritize carriers with regards to roadside inspections. ISS was developed by the Upper Great Plains Transportation Institute of the North Dakota State University. SafeStat and ISS have been recently integrated, which in practice means that ISS is now more or less using the SafeStat setup (which is more detailed and uses more data items than the original ISS).

Both ISS and SafeStat are tactical instruments for the optimization of government activities to improve road safety. Strategic (long term) instruments to measure the effectiveness of policy instruments are:

- Safe-Miles and Intervention Model: a tool developed by Volpe and the University of Maryland for the Office of Motor Carriers, to determine the effectiveness (in terms of decreasing the number of accidents and in monetary terms) of roadside inspections of commercial vehicles (intervention model also for traffic enforcement program).

- Compliance Review Impact Assessment Model (CRIAM): a methodology also developed by Volpe and the University of Maryland to measure the effectiveness of compliance reviews (company on-site inspections) of motor carriers.

## 14.2 Implications for the Netherlands

In SafeStat, the focus is mainly on the assessment of individual road haulage firms and the selection of companies with bad performance in the area of road safety. Different intermediary results are calculated for all companies, but SafeStat calculates an overall final result only for companies, which belong to the worst 25% in at least two out of the four Safety Evaluation Areas (SEA). In order to develop a selection tool that the Dutch IVW (Transport and Water Management Inspectorate (Inspectie Verkeer en Waterstaat), Transport Inspectorate Netherlands (Divisie Vervoer)) could use to identify the worst companies, SafeStat needs to be adapted to the Dutch situation (for example with respect to the available databases), but a substantial expansion is not necessary. It may be possible to integrate accident statistics, company registers and data from the compliance reviews and roadside inspection for The Netherlands in a single tool. However, in order to create a monitoring system to assess the efficiency of the activities of the IVW in traffic safety, it is necessary to expand the selection tool in the following ways:

- The tool should calculate a representative final result for the whole sector and not only for companies with weak performances:
  - All companies should be taken into account, or
  - A sample representative of all companies should be selected, or
  - Correction factors should be used in order to translate results from a sample where weak performers are over represented to the total of all companies on the market.

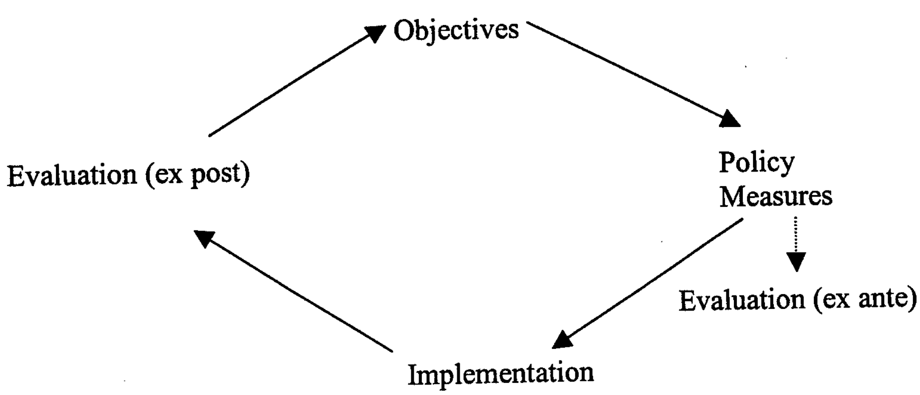
- Besides scores at a given moment in time for the safety performances of the haulage firms, the activities of the IVW should be quantified (for instance in money units or man hours), and their effects on traffic safety should be corrected for autonomous influences. SafeStat can serve as the basis for such a tool, because the impacts of the IVW on traffic safety happen through the behavior of firms with respect to safety. What is missing is the direct impact of the IVW on the firms. In Part III of this report, we shall submit proposals to develop on the basis of SafeStat an expanded tool, with which the performances of all the companies and the influence of the IVW on it can be assessed. We shall study more particularly the extent to which ideas from the American strategic policy assessment tools Safe-Miles/Intervention Model and the CR Impact Assessment Model can be applied to the Dutch situation. In doing this we must take into account that these instruments are only preliminary tools and –also for application to the American situation- need further development and refinement. Furthermore, repeated measurement of activities, performances in traffic safety and autonomous effects will be necessary for measuring the effectiveness of IVW activities.

# PART III. Proposal for application in the Netherlands

# 15. Introduction to Part III

In this part, an analysis is reported that aims at determining to which extent SafeStat can be applied to the Dutch situation, resulting in a detailed framework for a monitoring tool for activities of the IVW related to traffic safety. During this step the other tools developed in the United States are also taken into account (especially the Compliance Review Impact Assessment Model and the Intervention Model).

In this part III, instruments for various stages in the policy-making and evaluation cycle will be proposed. This cycle is depicted below. Given the policy objectives, policy measures are specified to reach the objectives. In ex ante evaluation these policy measures are 'tested' before they will actually be implemented (e.g. by using forecasting and simulation models). After the measures have been implemented, the measures can be evaluated ex post, particularly looking at the degree of goal achievement (the 'effectiveness' of the measures).




A worked-out proposal for a tactical selection-tool to prioritise carriers for compliance reviews and roadside interviews is presented in chapter 16. The data to be used, the measures and indicators proposed and the algorithms through which the different data items, measures and indicators are linked are described. In chapter 17, a proposal is developed for a tool to measure and monitor the effectiveness of compliance reviews, and in chapter 18 for roadside inspections. Both are strategic ex post evaluation tools. In chapter 19 we discuss possibilities for ex ante evaluation.

# 16. A proposed tool for prioritising carriers for compliance reviews and roadside inspections

## 16.1 General considerations

It is recommended that first a tactical instrument for calculating a safety score for firms in road freight transport be developed. This tool is in many ways similar to SafeStat, which was the first instrument developed in the US (for prioritising carriers for compliance reviews). This tool can then be used for prioritising carriers for compliance reviews and roadside inspections. It may be used to inspect a more than proportional share of unsafe carriers, but also to exempt safe carriers from inspections. In this chapter a worked-out example of this tool is provided. However it is recommended that this tool will only be implemented and used in practice, after a number of modifications have been made to reflect the outcomes of expert and stakeholder meetings. What is proposed is that the following description is used as a basis for consultations with stakeholders and experts. Stakeholders/experts, including inspectors, industry experts and insurers, could be asked to indicate which factors influence truck traffic safety, how this can be measured, but also to react to the proposed tool and the preliminary outcomes of this in terms of a ranking of carriers.

The tool described in this chapter 16 is a descriptive instrument, not a causal model or a controlled experiment. It is therefore not suitable for determining the effectiveness of compliance reviews or roadside inspections. Separate proposals for tools for measuring the effectiveness of compliance reviews and roadside inspections will be presented in chapters 17 and 18.

The tool described below deals with firms that operate road vehicles for freight transport (both hire and reward and own account transport). SafeStat is concerned with both trucks and buses, and many US regulations apply to motor carriers that can operate both buses and trucks. In the Netherlands the traffic safety regulations applying to trucks and buses are very different. The model for the Netherlands, described below, will focus on freight transport. An advantage of this is that it will be possible to include data in this instrument that is specific for freight transport (e.g. the weight of the load). At the end of this chapter we shall briefly discuss how a tool for bus companies can be derived from the tool proposed for firms that operate trucks.

It is recommended to develop this tool for calculating safety scores for the operations in goods transport within the Netherlands (including purely domestic transports and the parts on Dutch territory of international transports) of Dutch firms first, and extend it to foreign trucks used in the Netherlands (and maybe also information about the use of Dutch trucks abroad) in later stages.

In SafeStat four areas of safety evaluation (SEA) are described: accident, driver, vehicle and safety management. The total of the scores in these areas determine the SafeStat final result of a carrier. The relevance of these four areas for the Dutch situation was evaluated. Also the relationship and links between the four areas and the related assessments (especially to find out whether overlaps in definitions and registration systems exist) were studied. The outcome is that it is proposed that all four areas be used, and that a fifth SEA for hazardous materials be introduced:

1. In the Netherlands there are independent (independent from the inspections and reviews) crash data as well. This can be used in SEA1 on accidents.
2. Many of the laws and regulations that are enforced through roadside inspections and compliance reviews of IVW are related to driver-related aspects that could lead to accidents. This can be used in SEA2 on the driver.
3. Although the technical state of the vehicle is not checked in the IVW inspections and reviews, the IVW does check whether the weight of the load does not exceed the maximum amount laid down in the regulations and other aspects of how the vehicle has been loaded. This is crash-related information, which can be used in SEA3 on the vehicle.
4. Especially in the compliance review safety management checks are carried out. We hypothesize that this will have an impact on firm-related traffic safety and include it in SEA4 on safety management.
5. Inspecting the transport of hazardous materials in the Netherlands is a somewhat separate activity within the range of enforcement activities of the IVW. Also it is a policy priority in its own right. Conceptually, it also differs from the other accident categories, in that there are comparatively few accidents in the Netherlands involving hazardous materials ('small risk'). However, the potential consequences of such accidents are very large ('big consequences'), and are not only related to traffic safety, but also external safety. This will give an extra SEA, SEA5 on hazardous materials.

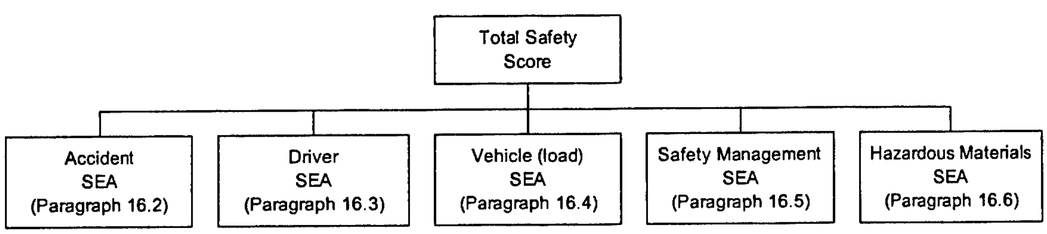



**Figure 3 Total Safety Score computational structure**

## 16.2 SEA 1: Accidents

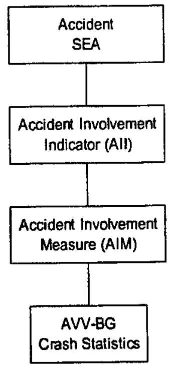



**Figure 4 Accident SEA computational structure**

*Measure and indicator based on AVV-BG crash statistics.*

First, the weighted number of accidents from crash data (WNA) needs to be computed for all crashes in which trucks (also possible for buses) were involved. Computation needs to be done per firm in road freight transport (bus transport). Period: last 3 years, with weights y1 (3 years back), y2 and y3 (last year); y1<y2<y3 (for example 1, 2 and 3 respectively).

WNA = a1 [Number of fatalities] + a2 [number of people hospitalised] + a3 [number of

non-hospitalised casualties] + a4 [number of property damage only crashes].

With: a1>a2>a3>a4 (for example 4, 3, 2, 1, but something based on societal cost would be better, given that this would not increase the variance too much; this would give a much higher weight to fatalities).

The connection between the AVV-BG crash data and the firms can be made by linking the crash data to the vehicle licence data first (information that AVV-BG has in the crash statistics; IVW is allowed to receive this), and then linking the vehicles to the firms (based on RDW, NIWO, SIEV data). The last step uses information that is not very reliable (lease companies, local branches instead of mother company), but this needs to be improved as we go along, e.g. on the basis of information supplied through the compliance reviews of the firms.

For normalisation we can use the number of vehicles per firm (from IVW data), NV, or the number of vehicle kilometres per year per firm (from CBS data), NVKM. This gives two alternative specifications for the accidents involvement measure (AIM):

AIM = WNA/NV or AIM = WNA/NVKM.

The second normalisation seems better: it is closer related to the probability of crashing ('exposure') whereas it is still unrelated – as a normalisation should be- to the safety-behaviour of the driver and the firm and the weight of the load. But we understood from the CBS that firm-specific vehicle kilometrage information cannot be made available. Therefore, the normalisation has to use NV.

To compare different firms with each other, the accident involvement measure needs to be converted into the accident involvement indicator (AII). This is done by ranking the firms on the basis of the AIM, from the highest AIM (worst) to the lowest (best) and assign percentile scores (100 for the worst firm, 0 for the best)[1]. We see no good reason to do this comparison for different peer groups, defined on the basis of the number of crashes per firm, especially since the number of crashes is not an exogenous variable in this system, but one of the main variables of interest. Peer groups of firms on the basis of an autonomous variable, such as the number of vehicles per firm could be tried, but given the limited amount of information that is available for reported crashes in The Netherlands, it is recommended that all firms with one or more crashes are compared together in calculating the indicator. At a later stage it may be decided to conduct the comparison on the basis of different groups of firms.

In SafeStat, firms must have at least 2 crashes in the last 30 months to receive a deficient indicator value (75 or more), but the indicator can be calculated for all firms. If the number of crashes is 0, the indicator value will be 0. The indicators should be based on a sufficient amount of data. We propose to calculate the AII for all firms as well, but with a value of 0 for all firms without crashes and 1-100 for the firms with crashes. As a result of this, many small firms will get a score of 0 on SEA1. This is an inevitable consequence of using crash data in the way described above. However, all unsafe small firms will show up in the data and can be selected for inspection on the basis of this instrument.[2] Likewise, safe medium-sized firms may not show up. For an instrument to select the unsafest firms and their vehicles for inspections, this seems to be quite acceptable. For a tool to determine the effectiveness of the IVW inspections we think this would also be acceptable, since all information on registered crashes is used in the tool, and all firms are taken into account.

*Measure and indicator based on crash data from compliance reviews*

If the number of vehicle crashes of a firm (say in the last year) would be asked and registered in the IVW compliance reviews (or if all firms would have to report the number of crashes to IVW on an annual basis), this source of information could also be used in SEA1. In Safestat, the compliance reviews provide data on the number of crashes in the last year, which is used in the recordable accident rate measure and indicator. The information required contains data of the crashes, a carrier identification, the number of crashes in the last 12 months and a normalisation variable (e.g. number of kilometres in last 12 months). We have not seen such variables in the description of the IVW BIC database, which contains the outcomes of the compliance reviews.

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[1] Alternatively, this can be done by calculating AII not on the basis of AIM but as a function of the vector (WNA, NV). This means that for a given NV, the expected value of WNA can be calculated. The AII of a firm is then computed from the probability that its WNA exceeds the expected WNA for a firm with this specific number of vehicles: is it unsafer than can be expected for a firm of this size?

[2] On the other hand, small firms that by chance have had an accident, will get a bad score.

Consequently, the outcome of SEA1 needs to be based solely on the AVV-BG accident data.

*Accident SEA value:*

As long as we only have accident data from AVV-BG, the accident SEA is equal to the AIM. If more accident indicators would be available, these could be combined by taking a weighted average.

## 16.3 SEA2: the driver

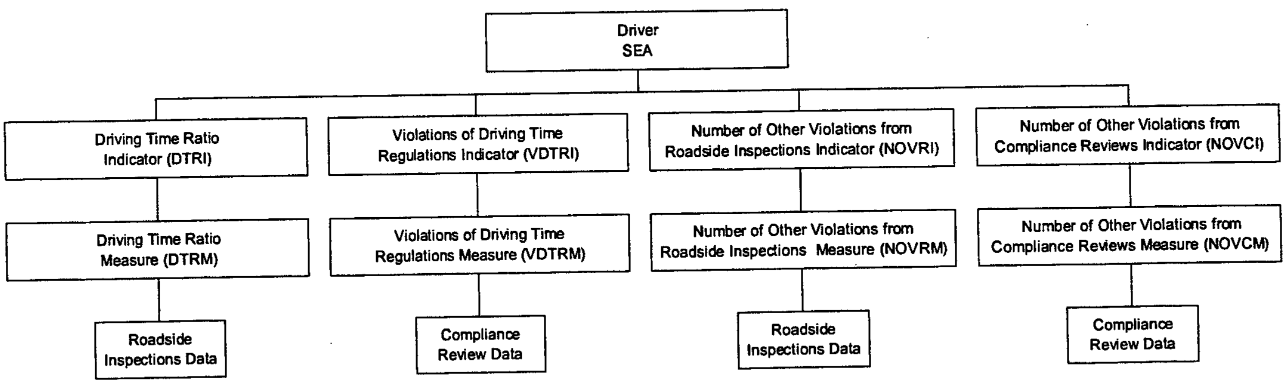



**Figure 5 Driver SEA computational structure**

*Measure and indicator based on driving/working/resting time violations from roadside inspections*

On the basis of the roadside inspections data, it might be possible to compute the driving time ratio measure (DTRM).

Computation needs to take place per firm in the road freight transport (also possible for bus transport). Period: last 3 years, with weights y1 (3 years back), y2 and y3 (last year); y1<y2<y3 (for example 1, 2 and 3 respectively).

From each truck driver, the following data are gathered. First for each driver (per vehicle), for each consecutive driving period (a trip or part of a trip): [actual driving time] and [maximum allowable working time].

Then sum over all vehicles (v) belonging to the same firm and over all consecutive driving periods (p) with the vehicle to get the DTRM:

DTRM = $\Sigma_v$ $\Sigma_p$ [actual driving time$_{vp}$] / $\Sigma_v$ $\Sigma_p$ [maximum allowable driving time$_{vp}$].

A further normalisation is not needed, since the division by the number of allowable hours already normalises the measure.

The reason to recommend this ratio instead of a measure based on the number of violations as in Safestat is that in The Netherlands there is a better hours registration (based on the tachograph) than in the US. We understood from IVW that for driving time violations, the severity of the violation (in hours) is registered in the BIC database. However, if the DTRM would not be feasible, an alternative measure would be to use the number of violations (summed over all vehicles belonging to the firm) of the driving/resting/working time legislation.

Another possibility is to use the number of driving time violations exceeding the allowable time by more than some pre-specified percentage. These measures would require a normalisation, e.g. by the number of vehicles per firm or number of inspections.

For comparing firms with each other, the driving time ratio indicator (DTRI) needs to be calculated. This can be done by ranking the firms on the basis of the DTRM (a higher value means unsafer) and assigning percentile scores (100 being worst and 0 best). Firms with 2 inspections in the 3-year period or less should not be used in the calculation of the DRTI (data sufficiency criterion). These firms should receive a DRTI of 0. It is recommended that all firms with more than 2 inspections in a single group are compared. If there would be a sufficient number of observations available, grouping by classes defined in terms of number of inspections would be possible.

*Measure and indicator based on driving/working/resting time violations from compliance reviews*

The number of violations of driving/resting/working time regulations (NVDT) in the most recent compliance review (given that this is no more than 3 years old) can be calculated.

Computation needs to take place per firm in road freight transport (can also be done for bus transport).

The violations of driving/resting/working time regulations ratio (VDTR) is defined as:

VDTR = NVDT/ NV

NV is the number of vehicles of the firm, for normalisation.

From the VDTR, the VDTI (violations of driving/resting/working time regulations indicator) is calculated by ranking all firms (including those with VDTR=NVDT=0, which is the best value) and assigning percentile scores (100 is worst).

*Measure and indicator based on other violations from roadside inspections*

The above-mentioned DTRM only takes into account violations of driving hours that were found during a roadside inspection. But other driver-related violations can also be observed during these inspections. These could include:

- Not possessing a permit for domestic or foreign transport; absence of the original permit in the truck;
- Absence of an employment certificate for the driver, a driving licence or a truck driver qualification certificate (for trucks > 7.5 ton).

Such other violations are included in the number of other violations from roadside inspections measure NOVRM (documents on the driver, permits, health of the driver, nighttime work), which is calculated per type of violation t:

NOVRM = $\Sigma_t$ [severity weight$_t$] [number of violations$_t$] / NV

Computation needs to take place per firm in road freight transport (also possible for bus transport). Period: last 3 years, with weights y1 (3 years back), y2 and y3 (last year); y1<y2<y3 (for example 1, 2 and 3 respectively).

Firms with 2 or less violations in the last 3 years will receive a number of other violations from roadside inspections indicator (NOVRI) of 0. For the other firms (all in one group), the NOVRI will be determined by ranking the firms and assigning percentile values.

*Measure and indicator based on other violations from compliance reviews*

The above-mentioned VDTR only takes into account violations of driving/resting/working time regulations that were found during a compliance review. But other driver-related violations can also be observed during these interviews. These are included in the number of other violations from compliance reviews measure NOVCM (documents on the drivers, permits, nighttime work), which is calculated per type of violation t:

NOVCM = $\Sigma_t$ [severity weight$_t$] [number of violations$_t$] / NV

Computation needs to take place per firm in road freight transport (also possible for bus transport), from the most recent compliance review in the last 3 years.

From the NOVCM, the NOVCI (number of other violations from compliance reviews indicator) is calculated by ranking all firms (including those with NOVCM=0, which is the best value) and assigning percentile scores (100 is worst).

*Other measures and indicators*

Maybe at a later stage violations of drivers recorded by the police (e.g. speeding, not obeying traffic lights) can be added.

*Driver SEA value*

The driver SEA value is defined as:

Driver SEA = [b1 DTRI+ b2 VDTI+ b3 NOVRI + b4 NOVCI] / [b1 + b2 + b3 + b4]

## 16.4 SEA 3: the vehicle (the load)

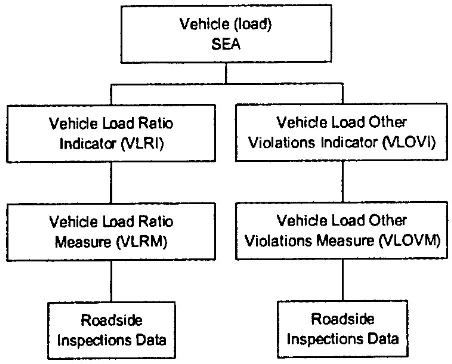



**Figure 6 Vehicle (load) SEA computational structure**

*Measure and indicator based on weight of vehicle load violations from roadside inspections*

On the basis of the roadside inspection data, it might be possible to compute the vehicle load ratio measure (VLRM).

Computation needs to take place per firm in road freight transport. Period: last 3 years, with weights y1 (3 years back), y2 and y3 (last year); y1<y2<y3 (for example 1, 2 and 3 respectively).

First gather for each vehicle that has been inspected: [actual weight of the load] and [maximum allowable load].

Then sum over all inspected vehicles v belonging to the same firm to get the VLRM:

VLRM = $\Sigma_v$ [actual weight of the $\text{load}_v$] / $\Sigma_v$ [maximum allowable $\text{load}_v$].

A further normalisation is not needed, since the division by the allowable load already normalises the measure.

We understood from IVW that the occurrences of vehicle load violations (distinguishing axle weight, total weight of a part of the vehicle and total weight of the whole vehicle) are registered in the BIC database. Also registered is a classification of the percentage overload and the action required for 3 classes (<10%, 10-20% and >20% for axle weight violations and <5%, 5-10% and >10% for vehicle weight violations). However, the quantitative registration of the weight is not yet sufficiently reliable, according to IVW. It is recommended to pay more attention to registering the actual weight and amount of overweight, so that the above measure, which is the most exact overload measure, can be computed.

If the VLRM would not be feasible, an alternative measure would be to use the number of violations (summed over all vehicles belonging to the firm) of the vehicle load legislation. This could use severity weights for the two times three classes mentioned above. Also violations other than overloading (e.g. not stowed properly, no proper documents on the load) could be included. These measures would require a normalisation, e.g. by the number of vehicles per firm or number of inspections.

For comparing firms with each other, the vehicle load ratio indicator (VLRI) needs to be calculated. This can be done by ranking the firms on the basis of the VLRM (a higher value means unsafer) and assigning percentile scores (100 being worst and 0 best). Firms with 2 inspections in the 3-year period or less should not be used in the calculation of the VLRM, and receive a VLRI of 0 (data sufficiency criterion). We recommend comparing all firms with more than 2 inspections in a single group. If there would be a sufficient number of observations available, grouping by classes defined in terms of number of inspections would be possible.

*Measure and indicator based on other vehicle load violations from roadside inspections*

If the VLRM can be calculated, we recommend including the other load-related violations in a VLOVM, a vehicle load other violations measure, by type t.

Computation needs to take place per firm in road freight transport. Period: last 3 years, with weights y1 (3 years back), y2 and y3 (last year); y1<y2<y3 (for example 1, 2 and 3 respectively).

VLOVM = $\Sigma_t$ [severity weight$_t$] [number of other vehicle load violations$_t$] / NV

For comparing firms with each other, the vehicle load other violations indicator (VLOVI) needs to be calculated. This can be done by ranking the firms on the basis of the VLOVM (a higher value means unsafer) and assigning percentile scores (100 being worst and 0 best). Firms with 2 inspections in the 3-year period or less should not be used in the calculation of the VLOVM, and receive a VLOVI of 0 (data sufficiency criterion). We recommend comparing all firms with more than 2 inspections in a single group. If there would be a sufficient number of observations available, grouping by classes defined in terms of number of inspections would be possible.

*Measure and indicator based on vehicle load violations from compliance reviews*

We could not find data on vehicle load violations from the compliance reviews. However, if these exist, a measure and indicator similar to that used for the roadside inspections could be constructed, based on the number of violations.

*Vehicle SEA*

In the absence of compliance review data on the vehicles (loads), the vehicle SEA is:

Vehicle SEA = [c1 VLRI + c2 VLOVI] / [c1 + c2]

Hopefully at a later stage data from the police might be added.

## 16.5 SEA 4: safety management

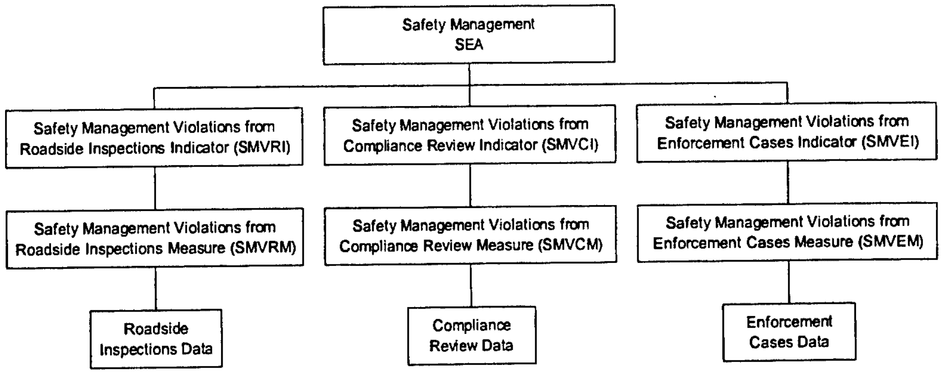



**Figure 7 Safety Management SEA computational structure**

*Measure and indicator based on management-related violations from roadside inspections*

The checklist for the roadside inspections needs to be studied and management-related violations need to be distinguished (if any in the roadside inspections) and be given a severity weight. Then the weighted safety management violations measure from roadside inspections (SMVRM) can be calculated.

Computation needs to take place per firm in road freight transport (bus transport). Period: last 3 years, with weights y1 (3 years back), y2 and y3 (last year); $y1<y2<y3$ (for example 1, 2 and 3 respectively).

$$SMVRM = \Sigma_t \,[\text{severity weight}_t]\,[\text{number of safety management violations}_t] / NV$$

In which SMVRM is the time-weighted and severity-weighted number of safety-management- related violations for the firm in roadside inspections in the last 3 years. NV is the number of vehicles of the firm (for normalisation).

The safety-management-related violations indicator from roadside inspections (SMVRI) is calculated by ranking the firms on the basis of the SMVRM and assigning percentile scores. All firms are in one group (firms without violations might be skipped).

*Measure and indicator based on management-related violations from compliance reviews*

The checklist for the compliance reviews needs to be studied and management-related violations need to be distinguished and be given a severity weight. Then the weighted safety management violations measure from compliance reviews (SMVCM) can be calculated.

Computation needs to take place per firm in road freight transport (bus transport), based on the most recent compliance review given that this is not more than 3 years old.

SMVCM = $\Sigma_t$ [severity weight$_t$] [number of safety management violations$_t$] / NV

In which SMVCM is the time-weighted and severity-weighted number of safety-management- related violations for the firm in the most recent compliance review in the last 3 years. NV is the number of vehicles of the firm (for normalisation).
The safety-management-related violation indicator (SMVCI) is calculated by ranking the firms on the basis of the SMVCM and assigning percentile scores. All firms are in one group (firms without violations might be skipped).

*Measure and indicator based on management-related violations from past enforcement cases*

The checklist for the enforcement cases (follow-up of compliance review for firms with unsatisfactory results) needs to be studied and management-related violations need to be distinguished and be given a severity weight. Then the weighted-safety management violations measure from past enforcement cases (SMVEM) can be calculated.

Computation needs to take place per firm in road freight transport (bus transport). Period: last 5 years, with weights y1 (4 or more years back), y2 (2 or 3 years back) and y3 (last year); y1<y2<y3 (for example 1, 2 and 3 respectively).

SMVEM = $\Sigma_t$ [severity weight$_t$] [number of safety management violations$_t$] / NV

In which SMVEM is the time-weighted and severity-weighted number of safety-management-related violations for the firm in all past enforcement cases in the last 5 years. NV is the number of vehicles of the firm (for normalisation).

The safety-management-related violations indicator on the basis of enforcement data (SMVEI) is calculated by ranking the firms on the basis of the SMVEM and assigning percentile scores for these firms between say 85 to 100 (worst). The lower boundary value (85 here) should be set at the fraction of firms not included in the enforcement cases. All firms with enforcement cases are in one group. Enforcement cases are only done for a limited fraction of firms with unsatisfactory outcomes during the compliance review. Firms without enforcement cases should get a SMVEI of 0.

*Safety-management SEA*

The safety management SEA is defined as follows:

Safety management SEA = [d1 SMVRI + d2 SMVCI + d3 SMVEI] / [d1 + d2 + d3].

## 16.6 SEA5: hazardous materials (hazmats)

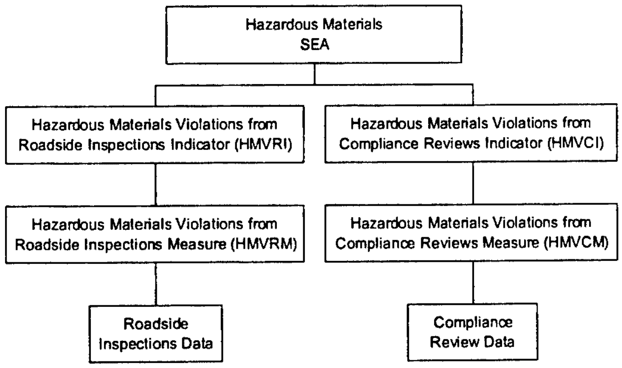



**Figure 8 Hazardous Materials SEA computational structure**

*Measure and indicator based on hazmat violations from roadside inspections*

The checklist for the roadside inspections needs to be studied and types (t) of hazmat violations need to be distinguished and be given a severity weight. Then the weighted hazmat violations measure from roadside inspections (HMVRM) can be calculated.

Computation needs to take place per firm in road freight transport. Period: last 3 years, with weights y1 (3 years back), y2 and y3 (last year); y1<y2<y3 (for example 1, 2 and 3 respectively).

HMVRM = $\Sigma_t$ [severity weight$_t$] [number of hazmat violations$_t$] / NV

In which HMVRM is the time-weighted and severity-weighted number of hazmat-related violations for the firm in roadside inspections in the last 3 years. NV is the number of vehicles of the firm (for normalisation), which in this SEA should be the number used for hazmat transport only.

The safety-management-related violation indicator from roadside inspections (HMVRI) is calculated by ranking the firms on the basis of the HMVRM and assigning percentile scores. All firms are in one group (firms without violations might be skipped).

*Measure and indicator based on hazmat violations from compliance reviews*

The checklist for the compliance reviews needs to be studied and hazmat violations need to be distinguished and be given a severity weight. Then the weighted hazmat violations measure from compliance reviews (HMVCM) can be calculated.

Computation needs to take place per firm in road freight transport, based on the most recent compliance review given that this is not more than 3 years old.

HMVCM = $\Sigma_t$ [severity weight$_t$] [number of hazmat violations$_t$] / NV

In which HMVCM is the time-weighted and severity-weighted number of hazmat violations for the firm in the most recent compliance review in the last 3 years. NV is the number of vehicles of the firm (for normalisation).

The hazmat violation indicator (HMVCI) is calculated by ranking the firms on the basis of the HMVCM and assigning percentile scores. All firms are in one group (firms without violations might be skipped).

*Hazmat SEA*

The hazmat management SEA is:

Hazmat SEA = [e1 HMVRI + e2 HMVCI] / [e1 + e2]

If only one of these exists, the hazmat SEA is equal to it. If both HMVRI and HMVCI do not exist, no hazmat SEA will be calculated.

## 16.7 Total safety score

The overall safety score from all 5 SEA's is:

Overall safety score = [f1 SEA1 + f2 SEA2 + f3 SEA3 + f4 SEA4 + f5 SEA5] / [f1+ f2 + f3 + f4 + f5]

In the American SafeStat, there is no f5 (this in included in SEA4), and f1=2, f2=1.5 and f3=f4=1. The weights to be used in the Netherlands should preferably come from consultations with stakeholders and experts. This can be done both by asking them about the importance of factors influencing traffic safety and by giving outcomes of trial runs of the instrument with initial weights.

## 16.8 Implementation of the tool

*Implementation in a PC program*

During the consultations with the stakeholders in later phases, this proposal (mainly about the choice of relevant indicators and weights) can be submitted.

One can get an impression of the sensitivity of the system, and in this way of the plausibility and validity of the system, through test calculations. When data or parameters are missing, while waiting for further phases and projects in this field, working hypotheses will be formulated (and varied in order to test the sensitivity) so that the test calculations can be done at this stage.

The formulae mentioned above have been implemented in a computer program. During later phases, IVW can use a revised version of this program as the base of an operational selection and monitoring instrument. After a possible adaptation following the consultation, the program could be tested in the field (part 5 in the AVV project plan from 12 September 2000).

*Using the tool to select unsafe firms for compliance reviews*

To get more effective compliance reviews the IVW can simply use the company identifiers and compare the safety scores from the tool between companies. Several interesting possibilities for the definition of the rules for selecting the companies to be reviewed exist. The answer to the question which set of selection rules is optimal, depends on whether and how one wants to take account of the requirements of measuring the effectiveness of the compliance reviews (see chapter 17) and whether this measurement should relate to all firms or just the unsafest firms.

Some possible sets of selection rules are given below

1. <u>Review only the unsafest firms (according to the new tool)</u>
The simplest selection rule would be to base all the compliance reviews on the outcomes of the instrument described above. If in a year a certain number of compliance reviews X can be carried out, then start assigning firms to the group to be reviewed, starting from the unsafest (the firm with the worst overall safety score), until the number X is reached. If compliance reviews among unsafe firms are more effective than among safe firms (this is very likely to be true, but there can be unsafe firms with a large resistance to change), then this is the most efficient allocation of resources for compliance reviews. However, this could imply that more or less the same group of firms would be reviewed every year, and many relatively safe firms would never be reviewed (which can be regarded as a good or a bad thing). Consequently, it would be impossible to reach statements about the effectiveness of a compliance review among an average firm (and thus all firms), and the data gathered in the compliance reviews (and used in the SafeStat-like instrument) would not cover the full range of firms, but only the unsafest firms. However, a measurement of the effectiveness of the compliance reviews as carried out in practice (under unsafe firms, not for an average firm) can be established; see next chapter.

<u>2. Unsafe firms get higher selection probability, safe firms lower probability</u>
- Oversample firms from the 25% unsafest group: 75% of all reviews.
- The next 25% firms: 15% of all reviews (somewhat less than proportional).
- The next 50%: 10% of all reviews (very much less than proportional: a high probability of not being reviewed).

In this sampling scheme, the different sampling fractions (stratified random sampling, with endogenous strata) could be used to correct the outcomes later to get a representative picture of the industry. This sampling scheme however makes measuring the effectiveness of compliance reviews in an unbiassed way rather difficult.

<u>3. Part of compliance reviews aiming unsafe firms, part random</u>
- first allocate 75% of the CRs to the 25% unsafest firms, and
- the remaining 25% CRs at random to all firms.

The advantage of this particular sampling scheme over the one with three groups (the second example), is that we can make sure that a part of the CRs is done for a random selection of firms, so that these can be used for an unbiassed measurement of the effectiveness of a CR for an average firm; see next chapter.

It would also be possible to concentrate the full reviews on the unsafest group and do more limited 'quick scan type' checks for the other firms.

*Using the tool to select unsafe firms for roadside inspections*

To make roadside inspections more effective, the IVW inspectors would need to be able to identify the vehicle and check its safety status. This could be done on the basis of the papers that the truck drivers are required to have with them. It would be better to have an identifier visible at the outside of the truck. This could be a special new sign on the truck, but preferably the IVW inspectors should have access to the licence plate numbers of all trucks and be able to check this directly on a laptop or by phone against the list with the safety scores of the firms as resulting from the tool described above. The decision rules might be (to be based on the score for the firm to which the vehicle belongs):

- Bad score: advice is: check.
- Good score: advice is: let go.
- In between: at the discretion of the inspector.

The above procedure is only possible if the inspectors have the licence plate numbers of all vehicles of firms that have a safety score (not just the vehicles that have been involved in crashes). Ideally this would be all firms. As long as this is not the case for all firms, the decision to inspect for a firm without a score would also fully depend on the inspector. For these firms the licence numbers of their vehicles would not be required, since it can not be used in practice (yet).

## 16.9 Other transport modes

The above selection tool refers to freight transport by road (trucks). In principle, similar tools could be developed for other transport modes for which the IVW carries out inspections. However this would require a separate study, and would probably lead to very different tools than the one described above, because the laws and regulations for these other modes are different and so are the available data. The American selection tool SafeStat refers to both trucks and buses, since the motor carriers legislation in the US and the roadside and on-site inspections relate to both trucks and buses. Because this is not the case in the Netherlands, the proposed selection tool only deals with trucks.

For firms operating buses, developing a safety scoring tool similar to that for firms operating trucks would also require a special study. As a starting point one could use the tool as proposed for trucks and compute only:
- SEA1 (accidents)
- SEA2 (driver)
- SEA4 (safety management).

SEA3 (the load) and SEA5 (hazmats) are not applicable for buses.

# 17. A proposed tool for monitoring the effectiveness of compliance reviews

For measuring the effectiveness of roadside inspections (at least the direct effect), at which defects are corrected, the methodology can be based on the crash probability for these defects if left undetected and uncorrected. Such a method is described in the next chapter. For compliance reviews there is not such a direct relation between corrected deficiencies and crashes. Therefore, a method based on actual corrections during the review is not very attractive for measuring the effectiveness of carrying out compliance reviews. The only methods left to establish the effect of doing a compliance review at some company are:

- Comparing the safety performance of the same firm using data before/at the compliance review (CR) and after the CR;
- Comparing the safety performance of reviewed firms with non-reviewed firms;
- A combination of both approaches.

A major disadvantage of the first method –which can also be relevant for other methods- is that the effect of autonomous factors on the traffic safety performance of a firm is not taken into account. A disadvantage of the second method is that both groups can differ not only in measured but also in non-measured attributes. Methods using this first method (e.g. the US tool CRIAM) usually attribute all the changes between the time points used to the compliance review effect. A possibly large part of the autonomous effect can be taken into account by using normalised measures, such as the firms average number of accidents per vehicle kilometer or per vehicle instead of the number of accidents per se. In this way impacts of changes in the size of the operations of the firm can be controlled for. But there may be other autonomous changes affecting the firms performance in traffic safety, e.g. changes in the amount of congestion, changes in regulations, traffic control measures.

In principle there are two methods for controlling for the autonomous effect on traffic safety:

- Developing a causal model of the various influences on traffic safety (e.g. regressions of the number of crashes per firm on firm-specific and general time-varying factors, such as traffic levels)
- Monitoring a control group that is not subjected to a compliance review.

More on the first option can be found in chapter 19 on ex ante evaluation. Defining a control group seems to us to be a more promising option. According to the sampling theory from statistics, the control group should be identical to the study group ('treatment group', here: CR group), not only in terms of measured attributes but also in terms of unobserved attributes. The latter homogeneity can not be measured, but the best possible guarantee is to select members of the treatment group and control group at random. This would imply that to measure the effects of compliance reviews, ideally one should assign firms to the CR group and the control group at random (e.g. by ranking all the firms alphabetically and defining the first 50% to be the CR group, from which a smaller subsample might be drawn if necessary). We are not sure whether it will be possible to accommodate this within the current compliance review mechanism, give the cost of doing a CR. In practice a considerable part of the compliance reviews, maybe even all reviews, will be done in firms that are considered to be relatively unsafe – certainly if a SafeStat-like tool for selecting the unsafest firms, as described in the previous chapter, would be introduced.

What might be done is the following:

- Take a (sub)set of firms that have been reviewed recently and that can be regarded as a random sample from all firms that could have been inspected.
- Then, a random sample is drawn from the non-reviewed firms.
- After this, both groups receive a questionnaire with questions on the size of the truck operations and on crashes in which their trucks were involved. Volpe's recent experience with such a survey for the second generation CRIAM has highlighted the importance of the wording of such a questionnaire. A survey with a questionnaire is necessary because the measurement should not take place in the form of the CR itself. Also a good response rate is required; it would be best to make answering this questionnaire (look) mandatory, as was done in the US.

This procedure is in many ways similar to what was done for developing the second generation CRIAM in the US. It would even be better if the same survey with the same questionnaire would take place before and after the CR for the firms that were reviewed and at the same point in time for the control group. In this case the procedure would be:

- Take a (sub)set of firms that will be reviewed in the next review period and that can be regarded as a random sample from all firms that could have been inspected.
- At the same time a random sample is drawn from the not-to-be-reviewed firms (see the 2 numerical examples below).
- Both before and after the review period both groups receive a questionnaire with questions on the size of the truck operations and on crashes in which their trucks were involved.

Preferably, this survey measurement should be a continuous effort, e.g. . a survey taking place every year. The outcomes of this can also be used in SEA1 of the tool to select firms for CR and roadside inspections.

<u>Numerical example 1 (hypothetical)</u>; complies with example 1 for the set of the selection rules for firms to be reviewed in section 16.8.

To clarify the method proposed above, let us assume that the population of firms operating in freight transport by road consists of 10,000 firms. The number of compliance reviews to be done in the next year is 1,000. Now let us assume that all 1,000 firms selected for a CR next year come from the group of 2,500 firms that is the group of the 25% unsafest forms (according to the prioritisation tool of chapter 16). 200

from these 1,000 firms are selected for the CR group. At the same time, 200 from the remaining 1,500 unsafe firms are selected for the control group. Then both groups are interviewed at say at the beginning of the year and at year end. During the year, the CRs are carried out among the 1,000 firms selected for this. The measured differences from the questionnaires give the effectiveness of the CR for the average reviewed firm (which are all unsafe firms). This result can then easily be extrapolated to all 1,000 CRs carried out in the year studied. The result can not be extrapolated to CR reviews that would be carried out among the 7,500 'safe' firms or all 10,000 firms. This method does not give the effect of a CR for an average firm, but if all CRs would be only be done for unsafe firms (following the tool of chapter 16), then it does give the effect of the CRs actually carried out. Moreover the CRs are probably done in the most efficient way here, because only unsafe firms are inspected.

Numerical example 2 (hypothetical); complies with example 3 for the set of the selection rules for firms to be reviewed in section 16.8

On the basis of the SafeStat-like instrument 750 firms (75% of the reviews, as recommended in section 16.8) are selected from the group of the 2,500 (25%) unsafest firms for a review. These are the unsafest firms according to the new tool. The other 250 firms to be inspected are selected at random from the population (but taking care that the same firm is not selected twice). These 250 firms can be safe or unsafe. For the CR group we take 200 from these 250 firms (all 250 would also be possible). For the control group we randomly sample from the 9,000 firms, that can be safe or unsafe and that will not be reviewed next year. Both groups receive the questionnaire before the CRs are carried out (say early in the year). After the CRs, the same two groups receive the questionnaire again (say end of the year). The measured differences between both groups are interpreted as the effects of the CR for an average (with respect to safety conduct) firm. This could be extrapolated to all 1,000 CRs carried out. Given that 75% of the firms that receive a CR are unsafe firms (according to the prioritisation tool), the average CR could be more effective than the CR for the average firm (there is more room for improvement).

Numerical example 3 (hypothetical); also broadly complies with example 3 for the set of the selection rules for firms to be reviewed in section 16.8

This example shows how we can measure both the effectiveness of CRs among the group of unsafe firms and among all firms. On the basis of the SafeStat-like instrument 900 firms are selected from the group of 2,500 unsafest firms. This sample is randomly split in a group of 750 to be reviewed and 150 not to be inspected. The other 250 firms to be inspected are selected at random from the population (but taking care that the same firm is not selected twice). These 250 firms can be safe or unsafe. For the CR group A we take 150 from these 250 safe or unsafe firms. For the CR group B we take 150 from the 750 firms. For the control group A we randomly sample 150 from the 9,000 firms, that can be safe or unsafe and that will not be reviewed next year. For the control group B we take the 150 unsafe firms, which are the non-inspected unsafe firms from the 900 initially selected. All four groups receive the questionnaire before the CRs are carried out (say early in the year). After the CRs, the same four groups receive the questionnaire again (say end of the year). The measured differences between both groups A are interpreted as the effects of the CR for an average (with respect to safety conduct) firm. This can be extrapolated to all 250 CRs carried out among the firms randomly selected for review. The measured differences between both groups B are interpreted as the effects of the CR for an unsafe firm. This could be extrapolated to all 750 CRs carried out among unsafe firms.

Given that the third example makes it possible to identify all the effects, it is recommended to follow this procedure, as well as the ensuing example 3 from section 16.8 for the selection of firms to be included in the CRs.

In addition, it is recommended to check beforehand (before the CR) whether the averages and standard deviations on the number of accidents of a CR group and its control group are similar. This can be done using the outcomes of the 'before' interview, but possibly also on the basis of the total safety score from chapter 16. In case of significant differences, a re-weighting of the control group may be necessary.

# 18. A proposed tool for monitoring the effectiveness of roadside inspections

In order to develop a tool for measuring the effectiveness of roadside inspections we recommend that a number of sessions is organised with experts and stakeholders: inspectors, managers of haulage firms, logistics and operations managers of shipping and haulage companies, drivers, insurers, academic and consultancy experts. The objective of these sessions should be to identify the risk level (meaning here: the probability of an accident) for each violation that may be detected and corrected during roadside inspections.

An example would be to ask (following the wording used to develop the Intervention Model):

*'A truck driver has been driving 13.5 hours, where 8.5 is the maximum allowed. If left uncorrected, what would you say the likelihood of a crash occurring would be, given the above scenario?'*

Instead of a single deficiency, several deficiencies could be combined in a single scenario, e.g. driving time violation and overload.

This tool might be extended to include traffic enforcement activities by the police (speeding, driver under influence of alcohol, vehicle deficiencies). In the US, the outcomes of similar sessions were used as a key input for the determination of the direct effects in the Intervention Model (RIM). The main questions to be asked in these sessions would be about the probability of a crash for each deficiency if left uncorrected (or the number of violations that corresponds to one crash). Answering these questions may be too difficult. In this case, using a 5, 7 or 9 points scale for the crash probability for a deficiency might make it easier for the respondents. Volpe used a 5-point scale with the category labels:

1. Violation is **potential single, immediate** factor leading to a crash;
2. Violation is **potential single, eventual** factor leading to a crash;
3. Violation is **potential contributing** factor leading to a crash;
4. Violation is **unlikely potential contributing** factor leading to a crash;
5. Violation has **little or no connection** to crashes.

After this, the risk probability for each scale level needs to be determined, by the experts/stakeholders, by the researchers or both.

Once the risk probabilities per violation would have been determined, the most difficult work would be completed. The rest of the work consist of:

- Combining the numbers of violations observed with the risk probabilities to get numbers of crashes avoided.
- Calculate the number of fatalities, injuries and damage-only-accidents for the avoided crashes, using average Dutch figures from the AVV-BG data.
- Place a monetary value on fatalities, injuries and damage only accidents; these values might come from the national or international literature (e.g. Hague Consulting Group, 2000).
- Compare the monetary value of crashes avoided with the monetary cost of carrying out the inspections from IVW data in a cost-benefit analysis.

Instead of placing a monetary value on the fatalities, injuries and damage-only-accidents, one could also compute a ratio with the number of fatalities (or injuries) as the numerator and the cost of the inspections as the denominator. This is called cost-effectiveness analysis instead of cost-benefit analysis. It can be used to select the most effective instruments (e.g. roadside inspections or compliance reviews), but not to determine whether these instruments generate net societal benefits. Cost-effectiveness analysis has been used in the evaluation of the safety measures in the National Transport Plan, NVVP (SWOV, 2000a,b,c,d).

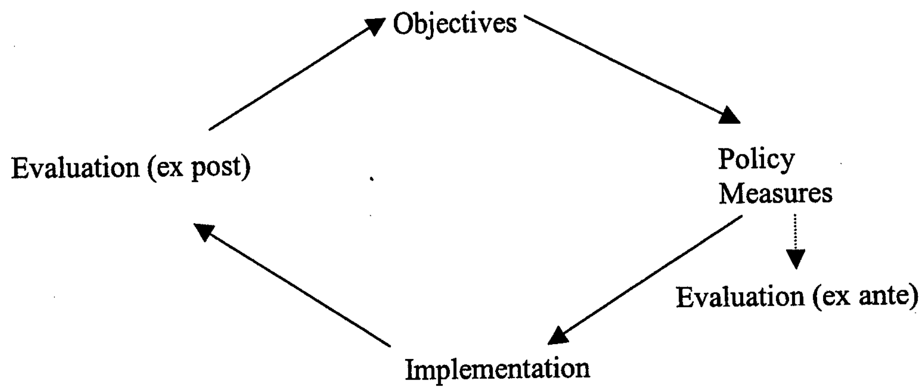
This only refers to the direct effects. The indirect effects need to be assessed by comparing inspected and non-inspected firms (control group) over time, similarly to what was discussed in the previous chapter about compliance reviews. These effects then can be added to the crashes avoided in the above list of steps. It would be simpler to compare the same firms before and after roadside inspections (e.g. one year apart, as in the intervention model) and attribute the differences to the roadside inspections. This however does not take into account that many other things may have changed during the year as well, which may also have affected traffic safety. Therefore it is much better to use a control group.

We have considered developing an instrument on the basis of the presently available information to obtain an approximation of the effect of roadside inspections that can be used while developing a better instrument as described above. As in SafeMiles, such a tool could use the idea that as a result of a roadside inspection, a number of miles following this inspection would not have crashes due to driver-related factors or load-related factors. In order to implement this, we would have to use assumptions on the duration of these effects (two or three months in SafeMiles). Certainly for the Netherlands this assumption is not supported by evidence. Likewise we would need an estimate of which fraction of truck-related accidents would be driver- and load –related. We don't have useful information which can be used for such an estimate, and would not be willing to support the use of US fractions for this (which did not have much of a solid empirical basis either). For the indirect effect, the SafeMiles method would require estimating a regression with the number of accidents as dependent variable and the number of roadside inspections as explanatory variable. The idea here is that this will show that firms with more roadside inspections will have less crashes. But causality also runs the other way around (dangerously looking vehicles are inspected more often), and there are many more causal factors that influence traffic safety. Consequently, we recommend against the application of a SafeMiles like instrument for the Netherlands: this would require too many unsupported hypotheses.

# 19. Possibilities for ex ante evaluation

*Purpose of ex ante evaluation*

The policy-making and evaluation cycle is depicted below.




In ex ante evaluation policy measures are 'tested' before they will actually be implemented (e.g. by using forecasting and simulation models). The main purpose for this is not to provide an accurate prediction of the future, but to distinguish between 'good' policies and 'bad' policies, by testing whether they will contribute (and if so, by how much?) to reaching the objectives. An evaluation can include formal quantitative methods, but also qualitative or even subjective elements. After the 'good' measures have been implemented, the measures can be evaluated ex post, particularly looking at the degree of goal achievement (the 'effectiveness' of the measures). Ex ante evaluation therefore can be similar to ex post evaluation, but it takes place at a different stage in the policy-making and evaluation cycle.

For the Traffic Inspectorate Netherlands (TIN), in particular for the activities aiming at increasing the safety of goods transport by road, ex ante evaluation could be used to:

- Compare the effectiveness in terms of accident-reduction for various types of activities that could be carried out in the future (e.g. compliance reviews, roadside inspection, introduction of new technologies, agreements on self-regulation within the sector); also: how many accidents could be expected without future IVW activities?

- Compare the effectiveness of different ways of carrying out certain activities (e.g. compliance reviews without a formal selection tool to identify unsafe carriers versus compliance reviews in which carriers are selected on the basis of such a tool).

*The tools in the US are all for ex post evaluation*

The tools developed in the US are either for tactical use (selecting unsafe carriers for compliance reviews and road side inspections) or for measuring the effectiveness of **past** enforcement activities. Safe-Miles gives the effectiveness of the roadside inspections in 1996, the Intervention Model uses data for 1998/1999. CRIAM is about the effectiveness of the CRs in 1996 (first generation CRIAM) or 1999 (second generation CRIAM). The outcomes of SafeMiles, the RIM and CRIAM have been used to show to Congress that the budget spent on roadside inspections and CRs has not been wasted, but has been used effectively. This is all ex post evaluation.

*Ex ante evaluation for the continuation of activities that are also carried out at present, and different ways of doing these*

Nevertheless, the outcomes of such **ex post** tools, as proposed in chapter 17 and 18, can also be used in an **ex ante** fashion, to determine a better future allocation of resources. The IV for the Netherlands (as proposed in chapter 18) might give that one euro spent on roadside inspections gives a societal benefit of 1.5 euros (hypothetical example). The CRIAM for the Netherlands (as proposed in chapter 17) at the same time could produce as outcome that one euro spent on compliance reviews gives a benefit of 2 euros[3]. In this case it would be efficient to spent more of the future budget on compliance reviews. By doing this, fewer unsafe firms would be included in the CRs and it can be expected that the marginal benefits of a CR would decrease. At the same time the marginal benefits of the roadside inspections would increase. An optimum can be found at the cross-section of the marginal benefits curves for both types of enforcement. These functions are not provided by the current RIM and CRIAM. But by using these tools over time, or by estimating functions on the underlying data, such functions could be derived, and the optimum allocation of resources determined in advance instead of by gradual adaptation of the budgets over time.

In the same way, such tools can be used to evaluate the cost-effectiveness of different ways of doing the compliance review or the roadside inspections (with and without a SafeStat-like tool). The impacts of compliance reviews without a selection tool and with a selection tool need to be measured ex post, by carrying out compliance reviews for a CR group selected by using the present non-formalised selection methods and a CR group selected on the basis of a new SafeStat-like tool. Both before and after the CR, both groups can be interviewed. The **ex post** measured difference in cost-effectiveness between both methods can then be used in **ex ante** evaluation, just as presented above for different activities of the IVW.

The above implies that information to be gathered (e.g. from expert opinions, as proposed in chapter 18) on the expected crash reduction per inspected truck can be combined (for instance in a spreadsheet program) with information on the number of truck inspections and truck-related crashes, to obtain:

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[3] A proper estimate of the cost of the inspections should not only include the cost of carrying out the inspections for the IVW, but also the cost for the inspected firms. Inspection and review methods should have the right effect on safety, but also, inasmuch as possible, avoid disturbing the operations of the firms.

- an **ex post** estimate of the effects of inspections, using data on the number of inspections in the past;
- an **ex ante** estimate of the effects of inspections, using data on the possible number of inspections in the future (possibly corrected for the increase in traffic volumes).

*Ex ante evaluation of current and new activities*

If one wants to evaluate (ex ante) the effects of continuing activities currently carried out (compliance reviews, roadside inspections) against effects of possible new activities (e.g. more emphasis on safety promotion campaigns, self-regulation in the transport sector, introduction of new technologies), then estimates of the effect of one euro spent on these new activities need to be made available. These could come from small-scale ('pilot') studies of such activities, results of research on the effects of such activities carried out elsewhere or expert opinions.

Another way to carry out ex ante evaluation, both for activities presently carried out and new ones, would be to develop an integrated causal model of accidents per firm. The above recommendations are all related to separate measurements of the effects on safety of individual activities. Developing a forecasting model of the number of accidents (by severity) of firms, that would include both external factors and policy variables would be a very ambitious effort. Two major recent studies into the effects of policy measures on traffic safety have chosen not to develop such an integrated model, but either to rely directly on the safety data or to use outcomes of many studies about effects of individual measures and expert advise. These two studies are discussed briefly below.

*Recent Dutch experience*

In the VeVoWeg study (Ministeries van V&W, VROM en BZ, 1998) and Schreuders et al. (1998), the AVV-BG data base of accidents has been used to come to conclusions on the likely effect of policy measures on road traffic safety. In this study tables have been made directly from the AVV-BG material on the reported causes of the accidents. For a minor proportion of the accidents additional police documents giving further information on the causes on the accidents could be added.

This study show that the most important causes for crashes with large trucks are factors that are not **directly** influenced by the IVW:

- Too small distance between vehicles, not giving way, overtaking on the right-hand lane;
- Health of driver, alcohol;
- Mistakes of the driver (e.g. too much to the left or right of the lane).

This does not necessarily lead to the conclusion that the activities of the IVW will only have a limited impact on truck safety. Without the outcomes of studies as proposed in chapters 17 and 18, there simply is not sufficient information for conclusions about the effectiveness of the IVW activities. The categories distinguished in the AVV-BG database, and used in the VeVoWeg study on causes of accidents are not appropriate to reach conclusions about the IVW inspections. Some of the above-mentioned most important causes could be related to fatigue and driving too long, and might indirectly be affected by enforcing the regulations on this. Disentangling the different causes of crashes is a very hard thing to do.

In the study into the effects, cost and cost-effectiveness of the policy measures to increase road traffic safety in the National Transport Plan (NVVP) of SWOV (SWOV, 2000a,b,c,d), a large number of policy measures aiming at reducing the number of fatalities and injuries have been evaluated. The NVVP has set objectives for the reduction in the number of fatalities and injuries requiring hospital admission until 2010. The SWOV translated these into the following targets for the period 1998-2020:

- a reduction of the number of fatalities by 300 (to 750 on 2010)
- a reduction of the of the number of injuries requiring hospital admission by 4,600 (to 14,000 in 2010).

These are reductions in the real number of injuries, taking into account an expansion factor for the incomplete registration of such accidents (no expansion for fatalities is required since nearly all fatalities are registered). The above numbers refer to all road traffic, not just to accidents that involved trucks.

The SWOV refrained from forecasting the number of injuries and fatalities that would occur in 2010 in the situation without the policy measures of the NVVP (baseline forecast). It states that on the one hand more accidents will result from the increase in mobility, and on the other hand the autonomous decline in the accident rates that has been observed can be expected to continue in the future. The SWOV argues that there is not sufficient reliable information available to quantify these two processes. Instead of predicting the 2010 'baseline', the SWOV assumes that these processes will balance each other. The 'baseline' for 2020 without the new policy measures therefore is simply the present number of accidents.

After this the SWOV made a list of NVVP traffic safety policy measures and classified the safety policy measures into four categories of measures, which is quite similar to the four safety evaluation measures of SafeStat:

- Infrastructure
- Influencing behaviour
- Vehicles
- Intelligent transport systems (ITS).

The effects of each measure were not based on an overall safety model, but came from previous detailed ex post studies and workshops (e.g. evaluation studies carried out in the past on the effects of photo-cameras along the roadside detecting vehicles that are speeding) or best guesses and assumptions. The effects were expressed in terms of reductions in the number of fatalities and injured requiring hospital admission.

Furthermore, in this study the cost of implementing each policy measure was determined. In a cost-effectiveness analysis, the effect (reduction in the number of casualties) is then divided by the cost for each measure. The SWOV did not convert casualties in to monetary losses, as in a cost-benefit analysis, but does recommend this for future research.

The most effective category of policy measures was the 'infrastructure' category, e.g. 30 km zones, roundabouts. The policy measures studied under the heading of 'influencing behaviour' did not contain measures for which the IVW is primarily responsible. This category contained projects about traffic speed, not obeying traffic lights, using alcohol and drugs, not wearing safety belt and helmet. The 'safety culture' programme for road freight transport gets a rather low cost effectiveness score, but it is noted that this programme will mainly result in a reduction in the property-damage-only accidents, which were not taken into account. One of the ITS measures is the implementation of an electronic tachograph or an on-board computer with crash recorder in trucks and vans. This appears to be a cost-effective measure. The SWOV notes that it does not have the information to quantify the effect of policies on overloading trucks.

Because the present activities of the TIN (especially compliance reviews and roadside inspections) are not included in the list of NVVP measures studied by SWOV, this study can not be used to get an approximation of the effects of these activities on safety. Also, there is no information available in the VeVoWeg study that provides an estimate (however rough) of the safety impact of the TIN activities.

*Development of a causal model*

Given that overall causal models of accidents in the Netherlands are missing, an ex ante model-based analysis of possible IVW activities, is only possible if new development of such models would take place.

Such a model could be estimated on data on accidents per firms (from the AVV-BG accidents database) for several time periods (panel data or repeated cross section, or combination) and data on possible explanatory variables. The type of models could be Poisson regression models or ordered response models, since the number of accidents (possibly severity weighted) per firm will only take a limited number of values, most often the integers 0, 1, 2.

The present AVV-BG database only contains a limited amount of data that could be used as regressor variables to explain the number of accidents per firm. Moreover, the causes of the accidents that are distinguished in this database, are not related to the activities of the IVW (as noted above in the discussion on the VeVoWeG study). It might be possible to link IVW data on violations of the laws that the IVW enforces (e.g. driving too long, overload) to specific accidents. This does not necessarily imply crash causation, but it can be used in a model of crashes as an explanatory variable. In the SafeStat-like instrument developed in chapter 16, linking the data from compliance reviews and roadside inspections to the accident statistics was proposed. If such a link could be established at the level of the firm, the same dataset could also be used to estimate a model explaining the number of crashes from –among other things- attributes of the firms and the number of roadside inspections and compliance reviews that the firm has had in recent years. If this linked dataset would become available, the time required for the estimation of the models, including reporting, would be 4-6 months.

However it can not be guaranteed that these models will be particularly reliable, nor that all major influencing factors will be included (there could always be discussion whether all important factors were in the model).

# 20. Summary and conclusions Part III

In Part III of this report, proposals have been presented for:

- *A tactical tool that can be used for selecting unsafe road freight transport firms* for:
    - compliance reviews and
    - roadside inspections.

  This tool calculates a safety score for every Dutch firm (carriers and shippers with own account transport) operating trucks for freights transport on the Dutch territory (either domestic transport or the Dutch parts of international transport). It is similar to SafeStat developed in the US. By focussing on the unsafe firms, the compliance reviews and roadside inspections can be done more effectively. This tool uses data from different sources:
    - the accident statistics form AVV-BG
    - data from the registration of IVW on the roadside inspections and the compliance reviews (BIC)
    - identifiers of vehicles and firms and information on the vehicle ownership per firm.

  This new tool distinguishes five areas of safety evaluation:
    - accidents
    - the driver
    - the vehicle/load
    - safety management
    - hazardous materials.

  Within each safety evaluation area, one or more measures are calculated which express safety (or rather unsafety) features of the firm. These measures are then converted into percentile scores (indicators). The indicators can be aggregated for each of the five areas and into an overall safety score for each firm, by weighting the various indicators according to their importance.

- *A strategic tool for the ex post evaluation of the effectiveness of the compliance reviews* (similar to CRIAM developed in the US).

  We recommend that a subsample of the firms operating trucks that will receive a compliance review (CR) in some year will receive a questionnaire, both before and after the CR, with questions about the transport volume and accidents they were involved in. The same before and after survey should be done for a control group, to separate the effects of the CR from other developments that might take place between the before-and-after survey.

If the tactical selection tool described above would be used to select unsafe carriers for compliance review, we recommend that not all firms are selected this way. For both the group of unsafe firms (selected using the tool) and for randomly selected firms, the before-and-after survey should then be carried out, for a subgroup of firms that received a CR and a control group, giving four groups in total.

- *A strategic tool for the ex post evaluation of the effectiveness of roadside inspections* (similar to the Intervention Model developed in the US).

  In the roadside inspections, deficiencies (e.g. overload, driving too long) are detected and also corrected. The heart of this tool would be a database of probabilities that a crash would occur if a deficiency had not been corrected. This database needs to be compiled in a number of expert sessions on truck safety.

  Once the risk probabilities per violation have been determined, the rest of the work would consist of:

  - Combining the numbers of violations observed with the risk probabilities to get numbers of crashes avoided.
  - Calculate the number of fatalities, injuries and damage-only-accidents for the avoided crashes, using average Dutch figures from the AVV-BG data.
  - Place a monetary value on fatalities, injuries and damage only accidents; these values might come from the national or international literature
  - Compare the monetary value of crashes avoided with the monetary cost of carrying out the inspections from IVW data in a cost-benefit analysis.

- *Methods for the strategic ex ante evaluation of actions* (continuation of current activities, introduction of new activities) of the IVW.

  The first three tools proposed above, all relate to ex post evaluation: determining the effectiveness of activities carried out by IVW in the past (or at present) or the present safety score of a firm. Some proposals have also been developed on ex ante evaluation: forecasting the effectiveness of activities of the IVW to increase road traffic safety in the future. These proposals are summarised below.

  The tools mentioned above for measuring the effectiveness of current activities of the IVW (such as compliance reviews and roadside inspections) can also be extrapolated into the future to give the expected impact of the continuation of such activities. This also applies to different ways of carrying out the compliance reviews and roadside inspections (e.g. on the basis of a tool selecting unsafe carriers for review and inspection versus the present selection of firms and vehicles without such a tool). The differences in effectiveness of two ways of selecting firms can be measured ex post by using both methods at the same time and interviewing firms selected using both methods. The ex post differences in effectiveness can be extrapolated into the future.

  If one wants to evaluate (ex ante) the effects of continuing activities currently carried out (compliance reviews, roadside inspections) against effects of possible new activities (e.g. more emphasis on safety promotion campaigns, self-regulation in the transport sector, introduction of new technologies), then estimates of the effect of these new activities need to be made available. These could come from small-scale ('pilot') studies of such activities, results of research on the effects of such activities carried out elsewhere or expert opinions.

Another way to carry out ex ante evaluation, both for activities presently carried out and new ones, would be to develop an integrated causal model of accidents per firm. The above recommendations are all related to separate measurements of the effects on safety of individual activities. Developing a forecasting model of the number of accidents (by severity) of firms, that would include both external factors and policy variables would be a very ambitious effort. It has not been done in previous studies on road traffic safety in the Netherlands. The data to be used would consist of the AVV-BG accidents statistics linked to the data from the compliance reviews and roadside inspections from IVW.

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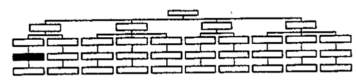
# Appendix A: SafeStat Algorithm

### *Accident Involvement Measure (AIM)*



First, a severity score is given to each crash (1.1):

(1.1) $$CSS = 1 + IF + HM$$

where *CSS* is the Crash Severity Score, *IF* is a Boolean for crashes which involved injury or fatality and *HM* is a Boolean for crashes where hazardous materials were released.

Then, the Total Consequence/Time Weighted Crashes for each carrier is calculated (1.2):

(1.2) $$TCTWC = 3 * \sum_{t=0}^{6} CSS_t + 2 * \sum_{t=7}^{18} CSS_t + \sum_{t=19}^{30} CSS_t$$

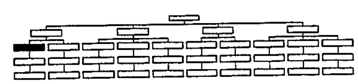
where *TCTWC* is the Total Consequence/Time Weighted Crashes and *t* is time (in months) in the past from the moment of calculation.

Finally, the Accident Involvement Measure for each carrier is calculated (1.3):

(1.3) $$AIM = \frac{TCTWC}{PU}$$

where *AIM* is the Accident Involvement Measure and *PU* is the number of power units.

### *Accident Involvement Indicator (AII)*



First, the carriers are grouped based on the total number of crashes per carrier, without time or severity weighting, into the following seven groups:

| Group | Number of State-reported crashes |
|---|---|
| 0 | 0 |
| 1 | 1 |
| 2 | 2-3 |
| 3 | 4-8 |
| 4 | 9-20 |
| 5 | 21-88 |
| 6 | 89+ |

Then, assign AII values in the following way:

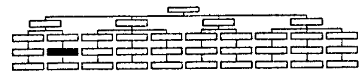
Group 0: Assign an AII of 0.

Group 1: Rank all the carriers' AIM values in ascending order. Transform the ranked values into AII percentiles from the 0 percentile (representing the lowest AIM) to the 74th percentile (representing the highest AIM).

Group 2 through 6: within each group, rank all the carriers' AIM values in ascending order. Transform the ranked values into AII percentiles from the 0 percentile (representing the lowest AIM) to the 100th percentile (representing the highest AIM).

Note: If a carrier has no crashes within the past 24 months, the AII will be capped at 74.

### *Recordable Accident Rate (RAR)*

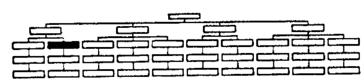


The Recordable Accident Rate is calculated as follows (2.1):

$$(2.1) \qquad RAR = \frac{1000000 * \sum_{t=0}^{12} RC_t}{\sum_{t=0}^{12} VMT_t}$$

where *RAR* is the Recordable Accident Rate, *RC* is the number of recordable crashes, *VMT* is the number of vehicle miles traveled and *t* is time (in months) in the past from the moment of calculation.

### *Recordable Accident Indicator (RAI)*



First, the carriers are grouped based on the total number of crashes per carrier, without time or severity weighting, into the following five groups:

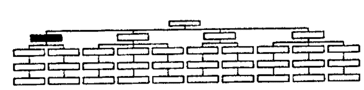
| Group | Number of Recordable Crashes |
|---|---|
| 0 | 0 |
| 1 | 1 |
| 2 | 2-4 |
| 3 | 5-19 |
| 4 | 20+ |

Then, assign RAI values in the following way:

Group 0: Assign a RAI of 0.

Group 1: Rank all the carriers' RAR values in ascending order. Transform the ranked values into RAI percentiles from the 0 percentile (representing the lowest RAR) to the 74th percentile (representing the highest RAR).

Group 2 through 4: within each group, rank all the carriers' RAR values in ascending order. Transform the ranked values into RAI percentiles from the 0 percentile (representing the lowest RAR) to the 100th percentile (representing the highest RAR).



### *Accident SEA*

Based on the availability of data, there are a few possibilities:

1 If no CRs were conducted in the past 12 months:

*Accident SEA* = *AII*

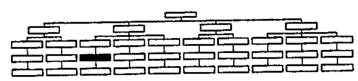
2 If a CR was conducted within the past 12 months and no new state-reported crashes have occurred since the CR was conducted:

*Accident SEA* = *RAI*

3 If a CR was conducted within the past 12 months, and a new state-reported crash has occurred since the CR was conducted:

*Accident SEA* = highest of *(AII, RAI)*

### *Driver Inspections Measure (DIM)*



First, time weight the inspection data (3.1, 3.2, 3.3):

$$(3.1) \quad TDPOOS = 3*\sum_{t=0}^{6} DPOOS_t + 2*\sum_{t=7}^{18} DPOOS_t + \sum_{t=19}^{30} DPOOS_t$$

where *TDPOOS* is the time weighted Total Driver Placed OOS, *DPOOS* is a Driver Placed OOS and $t$ is time (in months) in the past from the moment of calculation.

$$(3.2) \quad TDOOSV = 3*\sum_{t=0}^{6} DOOSV_t + 2*\sum_{t=7}^{18} DOOSV_t + \sum_{t=19}^{30} DOOSV_t$$

where *TDOOSV* is the time weighted Total Driver OOS Violations, *DOOSV* is a Driver OOS Violation and $t$ is time (in months) in the past from the moment of calculation.

$$(3.3) \quad TDI = 3*\sum_{t=0}^{6} DI_t + 2*\sum_{t=7}^{18} DI_t + \sum_{t=19}^{30} DI_t$$

where *TDI* is the time weighted Total Driver Inspections, *DI* is a Driver Inspection and $t$ is time (in months) in the past from the moment of calculation.

Then, determine the number of inspections that uncovered violations of OOS orders that have occurred within the last 30 months, and calculate the Jumping OOS Order Multiplier (JOOM) from the following table:

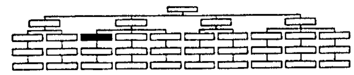
| Number of times of Jumping OOS Orders | JOOM |
|---|---|
| 0 | 1.0 |
| 1 | 1.2 |
| 2 | 1.4 |
| 3 | 1.6 |
| 4+ | 2.0 |

Finally, the Driver Inspections Measure is calculated for each carrier (3.4):

(3.4) $DIM = JOOM * \frac{(TDPOOS + TDOOSV)}{TDI}$

where DIM is the Driver Inspections Measure.

### *Driver Inspections Indicator (DII)*



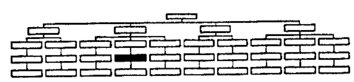
First, calculate the carrier's total number of driver inspections performed within the last 30 months and assign the carrier to one of the following groups:

| Number of Inspections | Group |
|---|---|
| <3 | 0 |
| 3-15 | 1 |
| 16-30 | 2 |
| 31-60 | 3 |
| 61+ | 4 |

Then, for each group, rank carriers' DIM in ascending order. Transform the ranked measures to DII percentiles from the 0 percentile (representing the lowest DIM) to the 100th percentile (representing the highest DIM).

Note: If a carrier has fewer than 3 driver OOS inspections then the DII will be capped at 74. Also, if a carrier has no driver OOS inspections, then it will receive a DII of 0.

### *Driver Review Measure (DRM)*



First, calculate the weighted Violation Value for each violation of critical regulations (4.1):

(4.1) $VVCR = SW * \left(10 + \left(\frac{O}{RC} * 10\right)\right)$

where *VVCR* is the Violation value for Critical Regulations, *SW* is the Severity Weight (1 for violations that are compliance or paperwork oriented and 2 for violations that are performance oriented), *O* is the number of Occurrences and *RC* is the number of Records Checked.

Second, calculate the weighted Violation Value for each violation of acute regulations (4.2):

(4.2) $VVAR = 3 * (10 + O)$

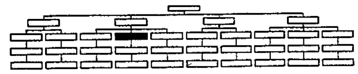
where *VVAR* is the Violation value for Acute Regulations and *O* is the number of Occurrences (set to a maximum of 10).

Finally, the Review Measure can be calculated (4.3):

(4.3) $RM = \sum VVCR + \sum VVAR$

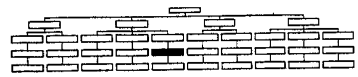
where RM is the Review Measure.

### *Driver Review Indicator (DRI)*



Rank carriers' DRM in ascending order. Transform the ranked measures to DRI percentiles from the 0 percentile (representing the lowest DRM) to the 100th percentile (representing the highest DRM).

### *Moving Violations Measure (MVM)*



First, time-weight the number of Moving Violations (5.1):

$$(5.1) \quad TMV = 3 * \sum_{t=0}^{6} MV_t + 2 * \sum_{t=7}^{18} MV_t + \sum_{t=19}^{30} MV_t$$

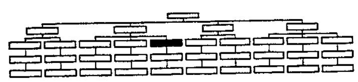
where *TMV* is the Time-Weighted number of Moving Violations, *MV* is a Moving Violation and *t* is time (in months) in the past from the moment of calculation.

Then, normalize the data with the number of drivers (5.2):

$$(5.2) \quad MVM = \frac{TMV}{D}$$

where *MVM* is the Moving Vehicle Measurement and *D* is the number of Drivers.

### *Moving Violations Indicator (MVI)*



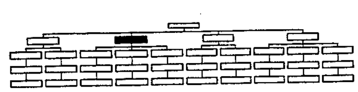
First, determine the carrier's total number of serious moving violations (without time-weighting) and assign the carrier to one of the following groups:

| Number of Moving Violations | Group |
|---|---|
| <3 | 0 |
| 3-9 | 1 |
| 10-28 | 2 |
| 29-94 | 3 |
| 95+ | 4 |

Then, for each group, rank carriers' MVM in ascending order. Transform the ranked measures to MVI percentiles from the 0 percentile (representing the lowest MVM) to the 100th percentile (representing the highest MVM).

Note: If a carrier has fewer than 3 moving violations then the MVI will be capped at 74.

### *Driver SEA*



There are a few possibilities:

1 If the MVI is greater than the maximum of the DRI and DII:

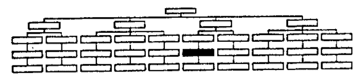
$$DriverSEA = \frac{(\text{highest of } (\text{DRI, DII})) * 2 + MVI}{3}$$

2 Otherwise:

*Driver SEA = highest of (DRI, DII)*

3 If none of the indicators exist (DRI, DII, or MVI) then the carrier has insufficient data for SafeStat to calculate a Driver SEA Value.

***Vehicle Inspections Measure (VIM)***



First, time weight the inspection data (6.1, 6.2, 6.3):

$$(6.1)\quad TVPOOS = 3*\sum_{t=0}^{6} VPOOS_t + 2*\sum_{t=7}^{18} VPOOS_t + \sum_{t=19}^{30} VPOOS_t$$

where *TVPOOS* is the time weighted Total Vehicle Placed OOS, *VPOOS* is a Vehicle Placed OOS and *t* is time (in months) in the past from the moment of calculation.

$$(6.2)\quad TVOOSV = 3*\sum_{t=0}^{6} VOOSV_t + 2*\sum_{t=7}^{18} VOOSV_t + \sum_{t=19}^{30} VOOSV_t$$

where *TVOOSV* is the time weighted Total Vehicle OOS Violations, *VOOSV* is a Vehicle OOS Violation and *t* is time (in months) in the past from the moment of calculation.

$$(6.3)\quad TVI = 3*\sum_{t=0}^{6} VI_t + 2*\sum_{t=7}^{18} VI_t + \sum_{t=19}^{30} VI_t$$

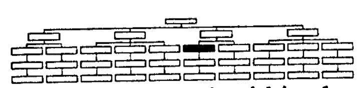
where *TVI* is the time weighted Total Vehicle Inspections, *VI* is a Vehicle Inspection and *t* is time (in months) in the past from the moment of calculation.

Finally, the Vehicle Inspections Measure is calculated for each carrier (6.4):

$$(6.4)\quad VIM = \frac{(TVPOOS + TVOOSV)}{TVI}$$

where VIM is the Vehicle Inspections Measure.

***Vehicle Inspections Indicator (VII)***



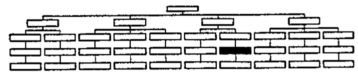
First, calculate the carrier's total number of vehicle inspections performed within the last 30 months and assign the carrier to one of the following groups:

| Number of Inspections | Group |
|---|---|
| <3 | 0 |
| 3-10 | 1 |
| 11-20 | 2 |
| 21+ | 3 |

Then, for each group, rank carriers' VIM in ascending order. Transform the ranked measures to VII percentiles from the 0 percentile (representing the lowest VIM) to the 100th percentile (representing the highest VIM).

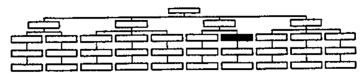
Note: If a carrier has fewer than 3 vehicle OOS inspections then the VII will be capped at 74. Also, if a carrier has no driver OOS inspections, then it will receive a VII of 0.

***Vehicle Review Measure (VRM)***



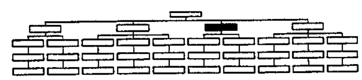
See Driver Review Measure.

***Vehicle Review Indicator (VRI)***



Rank carriers' VRM in ascending order. Transform the ranked measures to VRI percentiles from the 0 percentile (representing the lowest VRM) to the 100th percentile (representing the highest VRM).

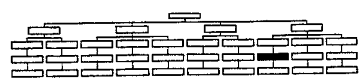
***Vehicle SEA***



*Vehicle SEA = highest of (VRI, VII)*

If only one of the two indicators (VRI or VII) exists, then that indicator is assigned to the Vehicle SEA Value. If neither of the indicators exists, then the carrier has insufficient data for SafeStat to calculate a Vehicle SEA Value.

***Enforcement Severity Measure (ESM)***



First, assign each enforcement case a time weight, using the following table:

| Age of Enforcement Case | Time Weight |
|---|---|
| 0-12 months | 4 |
| 13-30 months | 3 |
| 31-50 months | 2 |
| 51-72 months | 1 |

Then, assign a severity weight to each enforcement case by applying the number of different types of violations cited in the case, using the following table:

| Number of different violations Cited | Severity Weight |
|---|---|
| 1 | 1 |
| 2-3 | 2 |
| 4+ | 3 |

Then, calculate the enforcement case value for each Closed Enforcement Case (7.1):

(7.1) $ECV = TW * SW$

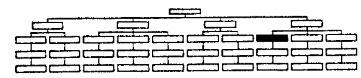
where $ECV$ is the Enforcement Case Value, $TW$ is the Time Weight and $SW$ is the Severity Weight.

Finally, the Enforcement Severity Measure is calculated (7.2):

(7.2) $EMS = \sum ECV$

where *EMS* is the Enforcement Severity Measure.

### *Enforcement History Indicator (EHI)*



First, place all carriers with an ESM into one of two groups:

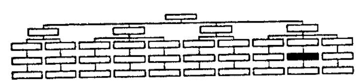
Group 1 (1) had a recent closed enforcement case (within 30 months) and no subsequent compliance review or
(2) had a recent closed enforcement case (within 30 months) and its the most recent subsequent compliance review resulted in violations of acute/critical regulations.

Group 2 (1) had its most recent closed enforcement more than 30 months ago or
(2) had a recent closed enforcement case (within 30 months) and had its most recent subsequent compliance review be "clean" (i.e., resulted in no violations of acute/critical regulations).

Then, rank carriers in Group 1 in ascending sequence by their respective ESMs. Assign each carrier's EHI a percentile ranking from 75 to 100 based on the carrier's ESM. The higher the ESM, the higher the percentile, and the worst the safety posture.

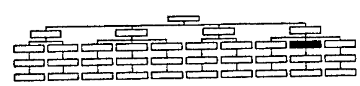
Finally, rank carriers in Group 2 in ascending sequence by their respective ESMs. Assign each carrier's EHI a percentile ranking from 50 to 74 based on the carrier's ESM.

### *Safety Management Review Measure (SMRM)*



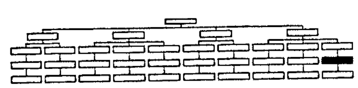
See Driver Review Measure.

### *Safety Management Review Indicator (SMRI)*



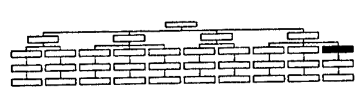
Rank carriers' SMRM in ascending order. Transform the ranked measures to SMRI percentiles from the 0 percentile (representing the lowest SMRM) to the 100th percentile (representing the highest SMRM).

### *Hazardous Materials Review Measure (HMRM)*



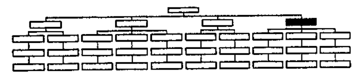
See Driver Review Measure.

### *Hazardous Materials Review Indicator (HMRI)*



Rank carriers' HMRM in ascending order. Transform the ranked measures to HMRI percentiles from the 0 percentile (representing the lowest HMRM) to the 100th percentile (representing the highest HMRM).

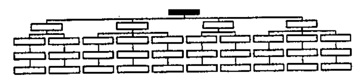
### *Safety Management SEA*



*Safety Management SEA = highest of (EHI, HMRI, SMRI)*

If only one of the three indicators (EHI, HMRI, or SMRI) exists, then that indicator is assigned the Safety Management SEA Value. If none of the indicators exists, then the carrier has insufficient data for SafeStat to calculate a Safety Management SEA Value.

### *SafeStat Score*



To obtain a SafeStat score, a carrier must be deficient in at least two different SEAs.

$$SafeStatScore = 2 * AccidentSEA + 1{,}5 * DriverSEA + VehicleSEA + SafetyManagementSEA$$

Note that SafeStat does not use SEA values that are less than 75 in calculating the SafeStat score.

# Appendix B: ISS-2 Algorithms

### *Safety Algorithm*

(1) If a carrier has been identified for monitoring in the PRISM 1 program, it automatically receives a Safety ISS-2 value of 100.

(2) The remaining carriers are placed in categories and groups based on their score in each Safety Evaluation Area (SEA) similar to those used by SafeStat (see Table B1). Note that the groups use the carrier's applicable highest SEA values.

(3) Within each group 1 through 11 and 16 through 26, the carrier's SEA indicators are summed placing 2 times as much weight on the Accident SEA and 1.5 times as much weight on the Driver SEA if applicable.

(4) For groups 12, 13, 14, 15, 28, 29, 30, 43, 44, and 45, the "sum" is simply the SEA value (the only one applicable).

(5) For groups 27 and 42 (with an Accident SEA value <75. AND no other value in any other SEA), they are placed in category I (with group 46)

(6) For groups 31 through 41, use the maximum of the Accident, Driver, Vehicle, and/or Safety Management SEA (for example, if a carrier received a Driver SEA of 49, a Vehicle SEA of 35, and an Accident SEA of 20, use the value 49 as the "sum").

(7) Starting with category A, all carriers are ranked based on their sum, then go to category B continuing the ranking, ... down through category F.
Note that these rankings (for categories A through F) are then assigned percentile ranks from 75 to 100.

(8) The remaining G and H categories are combined and ranked all together. However, category G (group 15) carriers should be ranked higher than all category H carriers.
Note that these rankings (for categories G and H) are then assigned percentile ranks from 1 to 74.

These percentile ranks (for all categories) then become the Safety ISS-2 inspection value.

| Category | Group | SafeStat SEA Values |
|---|---|---|
| A | 1 | Acc>=75, Drv>=75, Veh>=75, Saf>=75 |
| | 2 | Acc>=75, Drv>=75, Veh>=75 |
| | 3 | Acc>=75, Drv>=75, Saf>=75 |
| | 4 | Acc>=75, Veh>=75, Saf>=75 |
| B | 5 | Drv>=75, Veh>=75, Saf>=75 |
| | 6 | Acc>=75, Drv>=75 |
| | 7 | Acc>=75, Veh>=75 |
| | 8 | Acc>=75, Saf>=75 |
| C | 9 | Drv>=75, Veh>=75 |
| | 10 | Drv>=75, Saf>=75 |
| | 11 | Veh>=75, Saf>=75 |
| D | 12 | Acc>=75 |
| E | 13 | Drv>=75 |
| F | 14 | Veh>=75 |
| G | 15 | Saf>=75 |
| H | 16 | 50<=Acc<75, 50<=Drv<75, 50<=Veh<75, 50<=Saf<75 |
| | 17 | 50<=Acc<75, 50<=Drv<75, 50<=Veh<75 |
| | 18 | 50<=Acc<75, 50<=Drv<75, 50<=Saf<75 |
| | 19 | 50<=Acc<75, 50<=Veh<75, 50<=Saf<75 |
| | 20 | 50<=Drv<75, 50<=Veh<75, 50<=Saf<75 |
| | 21 | 50<=Acc<75, 50<=Drv<75 |
| | 22 | 50<=Acc<75, 50<=Veh<75 |
| | 23 | 50<=Acc<75, 50<=Saf<75 |
| | 24 | 50<=Drv<75, 50<=Veh<75 |
| | 25 | 50<=Drv<75, 50<=Saf<75 |
| | 26 | 50<=Veh<75, 50<=Saf<75 |
| | 27 | 50<=Acc<75 |
| | 28 | 50<=Drv<75 |
| | 29 | 50<=Veh<75 |
| | 30 | 50<=Saf<75 |
| | 31 | 0<Acc<50, 0<Drv<50, 0<Veh<50, 0<Saf<50 |
| | 32 | 0<Acc<50, 0<Drv<50, 0<Veh<50 |
| | 33 | 0<Acc<50, 0<Drv<50, 0<Saf<50 |
| | 34 | 0<Acc<50, 0<Veh<50, 0<Saf<50 |
| | 35 | 0<Drv<50, 0<Veh<50, 0<Saf<50 |
| | 36 | 0<Acc<50, 0<Drv<50 |
| | 37 | 0<Acc<50, 0<Veh<50 |
| | 38 | 0<Acc<50, 0<Saf<50 |
| | 39 | 0<Drv<50, 0<Veh<50 |
| | 40 | 0<Drv<50, 0<Saf<50 |
| | 41 | 0<Veh<50, 0<Saf<50 |
| | 42 | 0<Acc<50 |
| | 43 | 0<Drv<50 |
| | 44 | 0<Veh<50 |
| | 45 | 0<Saf<50 |
| I | 46 | No SEA value in any SEA |

**Table B1 Groups and ISS-2 Value Range in the Safety Algorithm**

### *Insufficient Data Algorithm*

Note that the Insufficient Data Algorithm is only applied if a carrier does not receive a score from the Safety Algorithm (Category I).

Alike SafeStat, all data is based on the past 30 months.

If a carrier has zero roadside inspections, assign an ISS-2 value based only on their size according to Table B2.

| Number of Power Units | | Number of Drivers | ISS-2 Value |
|---|---|---|---|
| 1001+ | *or* | 1001+ | 100 |
| 201-1000 | *or* | 201-1000 | 99 |
| 64-200 | *or* | 72-200 | 98 |
| 16-63 | *or* | 16-71 | 97 |
| 7-15 | *or* | 6-15 | 96 |
| 2-6 | *or* | 2-5 | 95 |
| 1 | *or* | 1 | 94 |

**Table B2 Groups and ISS-2 Value Range in the Insufficient Data Algorithm**

(1) Assign the carrier the higher of their values.
(2) If there is neither power unit information nor driver information, simply assign them the midpoint ISS-2 value of 97.

For carriers with one or more previous roadside inspections, determine their Inspection per Power Unit Rate, their Inspection per Driver Rate, and subsequent Inspection Average Rate as follows and rank from 50-100.

(1) The Inspection per Power Unit Rate is determined by dividing the number of Level 1, 2 and 5 inspections the carrier has had in the previous 30 months by the number of power units they indicate.
(2) The Inspection per Driver Rate is determined by dividing the number of Level 1, 2, and 3 inspections the carrier has had in the previous 30 months by the number of drivers they indicate.
(3) The Inspection Average Rate is then the average of these two rates (the Inspection per Power Unit Rate and the Inspection per Driver Rate). If one of the rates is unable to be determined (because of no power unit or driver information), the Inspection Average Rate is simply the rate, which can be determined.
(4) Using these Inspection Average Rates, a ranking of 50 to 100 is assigned to the carriers (the *lowest* Inspection Average Rates should get the highest rankings), which then becomes these carriers= ISS-2 values.

If there is no size information available to calculate the Inspection Average Rate (but, the carrier does have at least one inspection), the ISS-2 value is simply the arbitrary value, 92.

Thus, ALL carriers in MCMIS have a Safety ISS-2 value or an Insufficient Data ISS-2 value.

# Appendix C: Report on visit to FMCSA and Volpe on 5-9 November 2001, Han van der Loop, AVV

The visit of FMCSA and Volpe from November 5-9, 2001 by 2 representatives from the Transport Inspectorate Netherlands (TIN), 2 representatives from AVV Transport Research Center of the Ministry and 1 from RAND Europe was experienced as very cordial and useful. The plans for a monitor of TIN can be further developed and improved by the experiences of FMCSA and Volpe in the USA. Also, contacts were made with many representatives from FMCSA and Volpe. Not only with advisors, but also with inspectors, with managers and even with both directors. An elaborate report has been made in Dutch. This report describes some key aspects relevant for the Monitor of TIN. Also a report of the visit to Volpe by Gerard de Jong from RAND Europe in English has been included.

Since about 5 years FMCSA has developed a large database with data about transport carriers operating interstate in the US. Also carriers from Canada and Mexico with a permit for USA are included. This database contains about 80.000 carriers of about 300.000 registered carriers, representing about 80% of the trucks on the interstate roads. Most of the States use this system at the moment. Data included are: involvement in accidents, violations by the driver of hours of driving and rest , traffic violations (as observed by FMCSA and the states), technical shortcomings of the vehicle and safety management of the carrier including hazmats (e.g. type of material). These data are used for a safety-score of the carrier (Safestat available on internet). The data on hours of driving and resting in the USA are based on logbooks completed by the driver; a technological tool such as the tachographe in Europe has not been introduced so far. The development of the database and models started as a small-scale pilot. Meetings with stakeholders are regarded as important success factors to attain acceptance and to make the models useful.

Before using the database the method of inspection was based on knowledge and intuition of the inspector. To make the method of inspection more systematic, more effective and efficient, an Inspection Selection System (ISS) has been developed to select the carriers with the highest safety score and the carriers of which the least information is available in the database. For this purpose inspectors use the US-DOT-number, a number carriers receive from US-DOT to operate interstate and which has to be visible at the side of the vehicle. This system is used by many states as a tool for selecting vehicles for inspection. The decision to select always is made by the inspector on the basis of the local and actual situation.

To determine the effectiveness of roadside inspections and inspections of carriers (Compliance Reviews), models have been developed and data on the last 2 years have been analyzed. These analyses have a descriptive character and are based on assumptions developed with knowledge and experience of experts in the field. The structure of these causal models has been based on the demands of "stakeholders" (especially the inspectors, but also carriers, organizations representing carriers, shippers, assurance companies, etc.). Recently the methodology of these analyses has been improved substantially and is developing in the direction of causal (ex post-)evaluations identifying the effects of inspections. Some aspects still require attention: the quality of the data, the representativeness of the sample and the underpinning of assumptions on the effects of several components of the roadside inspection program, of the traffic enforcement program and of the compliance reviews.

The assignment of roles and tasks in recent years in the USA in developing knowledge and information for enforcement can be an inspiration for the Netherlands. Since recent years the FMCSA in the USA has been developed into a more autonomous "administration" within the Department of Transport and has taken a lot of initiatives to make information on safety and policy implementation available: develop, maintain and improve a database, take initiatives for the management, for legal aspects, training, policy reporting (White House, Congress), information, etc. Volpe has an advising role, develops new systems and models in command of FMCSA and does complex studies such as evaluation studies. During our explorations of the last years no comparative developments have been found in other countries in which the enforcement of transport road safety is monitored as systematically as in the USA.

# Appendix D: Report on visit to FMCSA and Volpe on 5-9 November 2001, Paul Huijbregts, AVV

| | |
|---|---|
| **Organization:** | U.S. Department Of Transportation (US DOT), Federal Motor Carrier Safety Administration (FMCSA) |
| **Location:** | FMCSA, Washington |
| **Meeting:** | 5 November 2001 |
| **With:** | Mr. Ralph Craft - Data analysis and information systems<br>Mr. Dale Sienicki - Division chief Data analysis & information systems<br>Mr. Joseph Clapp - Administrator FMCSA<br>Mrs. Retta Besse - Division Chief Professional Development & Training<br>Mr. John Grimm - Office Director Safety Programs<br>Mr. Jim McCauley - Team leader MCSAP Team<br>Mr. Ron Knipling - Science Adviser<br>Mr. Steve Dowling - California Highway Patrol |

## 1. GENERAL

- The emphasis of the US DOT (Department Of Transportation) is primarily on safety and a safe transport system. Aspects such as for instance social conditions belong to the responsibilities of other departments.
- The FMCSA is in charge of the enforcement of safety regulations in the motor carrier industry. The mandate applies to all commercial vehicles exceeding 10.000 pounds gross vehicle weight that are involved in interstate (including international) transportation. The FMCSA also has a mandate for busses that carry over 12 passengers as well as motor carriers carrying hazardous materials. This mandate is applicable to interstate as well as intrastate transportation.
- In the US there are approximately 500.000 active motor carriers, of which about 350.000 are interstate motor carriers involved in state cross borders operations. In total the industry represents about 8.000.000 trucks. The FMCSA has a total of 800 employees at its disposal. The police have another 7000 to 8000 employees. In the motor carrier industry, 25% of the carriers are considered to be unsafe. The percentage of small-sized companies (owner-driver) is high.

- The States receive their financial budgets for enforcement activities from the Federal Government (FMCSA) through an appointed organization in every individual State. In the State of California with about 1000 inspectors, this is for instance the Californian Highway Patrol (CHP). This organization has amongst others been established to perform inspections.
- To account for the budgets, the States have to draw a Commercial Vehicle State Plan covering the objectives, strategies and measures related to the activities of enforcement of safety.

## 2. SPECIFIC MONITORING SAFETY

**Data collection:**

- About two-thirds of all accidents, which involve freight vehicles, are reported.
- Data collection is not fully harmonized. All enforcement organizations work with a base (minimal) set of data that have to be collected.
- After reported accidents involving fatalities, a post crash evaluation is carried out to establish the cause of the accident.

**Experiences with the implementation and use of models:**

- There has been a lot of resistance from the enforcement bodies against the implementation of Inspection Selection System (ISS). Initially, ISS was considered to be a limitation of the possibilities and authorization of inspectors to inspect. The new-implemented system in some cases produced a negative recommendation to inspect ('satisfactory') for certain unsafe carriers. However, from the expertise and experience of inspectors it was obvious that these specific carriers actually did need an inspection. By improving the quality and quantity of the data for the model over time, the Safestat scores and the recommendations for roadside inspections have become more accurate. The model, however, is a supporting tool producing a recommendation to perform an inspection or provide a free passage (satisfactory, conditional, not satisfactory). The final decision to actually inspect a specific vehicle or not remains with the inspector.
- In order to have Safestat accepted by the States, the FMCSA made the software freely available. In exchange for the free software, the States are obligated to provide the FMCSA with crash data. This obligation is, however, not fulfilled by all the States.

**Experiences with safety:**

- Small carriers are generally less safe than other carriers;
- New entrants to the motor carrier industry are generally less safe than other carriers: this is the underlying reason why new entrants from now on receive the Safety Management Manual.
- In California a statistical relation has been proven between the consistency of enforcement and the effect on compliance.

**Development and training:**

- Development and training takes places for inspectors, the judiciary (e.g. specific expertise of judges related to the causes and severity of accidents and causes for effectiveness of prosecution of violations) and the motor carrier industry (preventive information campaign for carriers).

- Standardization of inspections between the States takes place from the FMCSA amongst others by means of the financing and training of inspectors.

**Developments:**
- Roadside Inspection Intervention Model is the successor to SafeMiles.
- The start-up of the New Entrants Program specifically focused at monitoring new entrants to the market and small operators.

**Before Safestat: MCMIS:**
The precursor to Safestat, MCMIS (Motor Carrier Management Information System) traces motor carrier by means of the size of the company, the number of trucks and drivers per company and a description of the generally carried type of cargo. Furthermore, MCMIS collects safety related data such as crash reports, enforcement activities and roadside inspection results.

- census file: each motor carrier must submit data: 500.000 carriers are 500.000 files.
- inspection file: 2.000.000 roadside inspections per year.
- crash file: 100.000 crashes per year.
- compliance review file: 10.000 compliance reviews / company visits per year.
- enforcement file: 2000 enforcements per year.

The census file provides the least quality of information. The enforcement file provides the best quality of information.

In the assessment of the compliance and safety of motor carriers with MCMIS, a systematic approach of the maximization of the use of data was missing. The objective was to include more additional data related to crashes, enforcement and roadside inspections that would lead to a netter identification of unsafe motor carriers. This has eventually led to the development of Safestat.

The system has offered possibilities for benchmarking in time, assessment of the performance of States on safety and to concentrate on the 100 most unsafe motor carriers.

**Organization:** U.S. Department Of Transportation (US DOT), Federal Motor Carrier Safety Administration (FMCSA)

**Location:** Roadside inspection site Maryland, FMCSA, Washington

**Meeting:** 6 November 2001

**With:** Mr. Mike Lamm - Enforcement Team Leader

Morning: visit of inspection facility Maryland Department of Transportation
Afternoon: presentation Mike Lamm (see website FMCSA for more details)

Research to the relation of crashes with fatigue is carried out by Debbie Freund.

In Safestat there 6 main factors that determine the Safestat rating:

- Factor 1: General: part 390, 387: *minimum level of financial responsibility,*
- Factor 2: Driver: part 382, 383: *use of alcohol*
- Factor 3: Operational: part 392, 395: *traffic regulations, driving and resting times*
- Factor 4: Maintenance: part 393, 396: *maintenance standard,*
- Factor 5: Hazardous materials: part 171, 177, 180, 397: *tanks, driving & parking*
- Factor 6: Number of crashes:

| | |
|---|---|
| **Organization:** | U.S. Department Of Transportation (US DOT), Federal Motor Carrier Safety Administration (FMCSA) |
| **Location:** | FMCSA, Washington |
| **Meeting:** | 7 November 2001 |
| **With:** | Mr. Jeff Loftus - Transportation Specialist (ICT, telematics, technical)<br>Mr. Jim McCauley - Team leader MCSAP Team<br>Mr. Steve Dowling - California Highway Patrol<br>Mr. Joe Solomey - Enforcement and regulatory affairs<br>Mr. Ralph Craft - Data analysis and information systems<br>Mr. Tom Keane - Data analysis and information systems |

**Future developments**
There are views and developments going to use transponders not only for selecting the worst carriers for inspection, but also to give safe operators a free passage at road inspection sites: i.e. selective enforcement both at the most unsafe and most safe ends of the motor carrier industry. There are also views to use data from the motor management system of trucks for enforcement purposes.

**Consistency in data collection** is safeguarded as much as possible by the free software that has been made available. The ultimate value and use of the program is determined by the data and information that is put in the model. The cooperation of the inspectors is therefore of essential importance for the Safestat model. The inspections in the States are, however, primarily focused on the transportation of persons. Transportation of freight is of minor importance. Only 5% of the inspections concern freight trucks.

The **objectives** sometimes diverge between the political arena, the Federal Government and the States. Once a political objective is set, it is not changed or altered anymore. An example is the objective to reduce the absolute number of traffic fatalities by 50% (disregarding for instance the growth in traffic). The State of California, however, relates the objective of a reduction of traffic fatalities to the growth of traffic (mileage).

Due to the fact that the Federal Government focuses on the most unsafe operators, the presumption arose in the rest of the motor carrier industry that this would mean a bad image in the media for the whole industry. According to the industry, there is a clear difference in safety performance. Consequently, the Federal Government conducted a study into whether bad motor carriers have a significant worse safety standard than the whole industry. The conclusion of the study was that no significant difference in safety standards could be proven.

The analysis of precrash factors and data show that many drivers are often unhealthy and work at very irregular times. The biological rhythm is often disturbed by irregular working and resting times.

**Legal aspects**
In the past, the FMCSA has been charged by carriers because the carrier's obligation to participate in a rating system should formally have been presented to the public for comments before coming into force.
The FMCSA has invested to sponsor judges and to train them for specific aspects of the motor carrier industry. In a number of cases, the accused party was not convicted by the judge because the latter could not adequately assess the reality and severity of the cases.

**The use of Safestat by third parties**
There has been an exchange of expertise with insurance companies. These have a higher frequency of contact with all carriers in the industry and also a different approach to safety risks. Safestat, however, offers a good basic source of information for insurance companies. Insurance companies check the safety philosophy of carriers mainly in a qualitative way. They, for instance, place the emphasis on drivers and safety management of carriers (e.g. how is safety organized within the organizational structure of a carrier: does a safety manager report to the operational manager or directly to the general manager) and not the trucks. This different approach makes it very difficult to use data from insurance companies for the quantitative approach and enforcement of regulations by the FMCSA.

Safestat is also used by motor carriers themselves: by means of the type of crashes in which a carrier has been involved, one can obtain information from the website of the FMCSA on what counter measures (the so-called Safety counter measures) can be taken in order to prevent or reduce the chances of being involved in that particular type of crash again.

**Organization:** U.S. Department Of Transportation (US DOT), Volpe National Transportation Systems Center (Volpe)

**Location:** Volpe, Cambridge Boston

**Meeting:** 8 November 2001

**With:** Mr. Don Wright - Developer Safestat
Mr. Dave Madsen – Developer Safestat
Mr. Bill Lyons

**Definition**

Safestat is related to the commercial interstate transportation. This means:

- Transportation between States and international transportation;
- Own account (private) transportation as well as hire and reward (commercial) transportation;
- trucks with a gross vehicle weight exceeding 10.000 pounds;
- busses, coaches with a minimum of 12 passengers;
- that every motor carrier has a US Department of Transportation (US DOT) number for an unambiguous identification.

**Input for Safestat has been taken from:**

- the OMC prioritization (OMC: Department of Transportation's Office of Motor Carriers);
- OMC safety rating;
- Meetings with stakeholders to define combined interests: representatives of enforcement bodies, the motor carrier industry, shippers, insurance companies , public parties etcetera.
- experiences and expertise with the ACAS system: Air Carrier Analysis System;
- the system CVOR (Ontario, Canada);
- the Highway Carrier Monitoring System (Quebec, Canada);
- FAA (Federal Aviation Agency): Safety Performance Analysis System (SPAS).

In the industry there is a great diversity of carriers: there is a large distribution on indicators from carriers varying from data of extremely large carriers to owner-driver companies. In order to be able to compare the data with one another, to give all carriers equal chances to be included in a group and to put the outcomes in the right perspective, the following subgroups have been defined:

25%: compare large motor carriers with large motor carriers
25%: compare medium-sized motor carriers with medium-sized motor carriers
25%: compare small motor carriers with small motor carriers

Without grouping, aselective roadside inspections would impose higher chances for the largest carriers with the largest fleet to be selected for inspection. Small motor carriers would consequently have a very small chance to be selected for inspection.

How often is Safestat adjusted to changes in, for instance, the structure of the industry?

Safestat is adjusted by means of equal distribution of carriers over the categories. The model Safestat has now been running for the last 4 years in 12 runs. For the last 2 years (4 runs) the data is truly comparable.
Developments like for instance lease companies by which trucks and trailers are subcontracted to motor carriers are not explicitly taken into account. The ownership remains with the lease company, while the motor carrier is using the equipment (either safe or unsafe) in its operations.

For the determination of weights, time intervals and categories in amongst others the Safestat model, qualitative analyses are used such as expert judgments by means of work sessions with stakeholders and experts.

Usually when a motor carrier indicates poor performances in a roadside inspection, it will also show poor performances with a Compliance Review (CR). In a number cases this has not been the case.

At this moment, about 80.000 motor carriers have a Safestat-score. This is representative for the whole industry. Every carrier has a chance to be selected and stopped for a roadside inspection and every motor carrier has a chance to get a Compliance Review, every motor carrier has a chance of being involved in a crash.

**Organization:** U.S. Department Of Transportation (US DOT), Volpe National Transportation Systems Center (Volpe)

**Location:** Volpe, Cambridge Boston

**Meeting:** 9 November 2001

**With:** Mr. Don Wright - Developer Safestat
Mr. Dave Madsen – Developer Safestat
Mr. Dennis Pickalow - Data systems / analysis

## FEEDBACK OF OUTCOMES OF MODELS AND ENFORCEMENT FOR GOVERNMENT POLICY AND REGULATIONS

The feedback of outcomes of enforcement activities and instruments for Government policy is being development at this particular moment. Feedback is not taken place in terms of adjustments in laws and regulations, but in the reports on the effectiveness of programs.

**The beginning of CVIS**
It is important that the positive effects and advantages of the use of new instruments on a small scale are directly visible to maintain the interests of stakeholders. This is important because the whole process is long in terms of time.

Presentation Dennis Pickalow: **Roadside Inspection Intervention model**
(see: http://ai.volpe.dot.gov/safestat/safestat.asp?file=method.pdf)

- Effectiveness of roadside inspections on crashes avoided;
- Effectiveness of traffic enforcement inspections on crashes avoided;
- Presented data and outcomes based on 1998/1999;
- The assumption that there is a positive relation between driver/vehicle violations and crashes. So with a reduction in the number of violations, the intervention is proof for the number of crashes avoided as a result of intervention;
- Empirical data is missing, risk levels and crash risks are estimated by means of expert judgments. For instance placing weights upon the types of violations (risk categories 1 to 5 with the respective crash probabilities). Many qualitative data has been determined by means of expert judgments;
- Conservative assumptions have been used to keep both the model and the results conservative so that the effectiveness of inspections will at least not be overestimated.
- The algorithm takes into account the case that multiple violations are detected during a single inspection: this will lead to an increased risk level.
- Because the inspections are often combined (for instance a vehicle is stopped for speeding and is subsequently checked for all other inspection levels: inspection level 1, 2, 3 ,4 etc. ) an allocation has been made in the model for the effects resulting from traffic enforcement en the effects resulting from roadside inspections. Hereby it is possible to get an estimate of the effects of roadside inspections only.
- Direct effects (avoided crashes based on the number and type of violations observed during a specific period of time) and indirect effects (the deterrent effects of

inspections over a longer period of time: measure the reduction in the number of violations and avoided crashes in later period of time that are accounted for due to the exposure to inspections in an earlier period of time) of inspections. Data of specific motor carriers are compared and measured over two different periods in time (for definitions of direct and indirect effects: see presentation sheets).

- For the direct effects of the Roadside Inspection Intervention model both precash as well post crash data has been used.
- Future planned developments concern:
  - improvements of the assumptions related to the crash risks (estimated by expert judgments) by means of causal studies.
  - furthermore research (amongst others fleet surveys) to and comparison with that part of the population that has not been inspected (significant differences).
  - analysis to identify safety measures for motor carriers to further reduce their crash risks and number of crashes (the objective of a 50% reduction in the number of crashes is converted into 22 measures)
  - possibilities for motor carriers to compare themselves on safety performance with other individual motor carriers and the total motor carrier industry.

**Organization:** U.S. Department Of Transportation (US DOT), Volpe National Transportation Systems Center (Volpe)

**Location:** Volpe, Cambridge Boston

**Meeting:** 9 November 2001

**With:** Mr. Richard Bates – Regional FMCSA, State of Massachusetts
Mr. Don Wright - Developer Safestat
Mr. Dave Madsen – Developer Safestat

## FINDINGS OF THE REGIONAL FMCSA STATE OF MA RELATED TO THE USE OF SAFESTAT

- Initially Safestat was regarded as a threat, because the system could take away a significant share of the responsibilities and authorizations to inspect from the roadside inspector.
- It is important that the data from the outcomes of inspections are entered into the system as soon as possible to keep the system itself up to date and to maintain a high level of quality of model output. In a number of cases, the data was already a few months old before data-entry took place.
- In the beginning, in a number of cases the recommendations from Safestat were not in line with the expertise and experiences of inspectors regarding the safety status of specific motor carriers. For a number of carriers, that were known to be unsafe operators, Safestat recommended not to inspect. Therefore the data output was verified with the expertise of inspectors to check whether the data was correct and complete.
- External effects: the inspection activities are fairly and equally distributed throughout the year. External effects should therefore not influence the outcomes of the Roadside Inspection Intervention Model determining the effectiveness of inspections on safety to a great deal.
- Effectiveness of inspections is also related to the enforcement measures that a inspector is authorized for: free of obligations versus compulsory.

**Organization:** U.S. Department Of Transportation (US DOT), Volpe National Transportation Systems Center (Volpe)

**Location:** Volpe, Cambridge Boston

**Meeting:** 9 November 2001

**With:** Mr. Don Wright - Developer Safestat
Mr. Dave Madsen – Developer Safestat

Identification of motor carriers:

- International: based on DOT number;
- Interstate: based on DOT number;
- Intrastate: not possible yet, although currently under review.

See website for Volpe report related to new entrants.

## REMARKS RELATED TO THE MODELS IN GENERAL

- The quality of data and the collection of information for historical time series changes through time. The change in the quality of data, however, spreads out (relatively).
- All motor carriers statistically have a chance to be involved in a crash.

## CR IMPACT ASSESSMENT MODEL (SEE HAND-OUT)

(estimating the advantages of performing CRs by estimating the reduction in the number of crashes and lives saved and avoided injuries).

- The changes in the crash risk is determined by comparing pre-compliance and post-compliance data of two measuring moments with one another. For this purpose the kilometrage performed between these two moments in time are necessary.
- All motor carriers with a CR in 1998 received a written questionnaire form in 1999. This was then followed in 2000 by the study and analysis of the returned data. Response rate in the motor carrier industry was very high due to the fact that the participation in the research more or less indicated to have a compulsory character (formal / official approach).
- The outcome of the research was that the average crash rate was reduced by 10.2%. By comparing the data with a control group over the same period in time, it was concluded that in the questionnaire 20% more crashes were reported than in the CRs. The hinter lying reason is that carriers use a different definition of a crash then the researchers. Motor carriers also reported crashes involving only material damages. Based on these findings, the initial outcomes were reduced by 20%.

## FINDINGS FOR THE IVW MONITORING SYSTEM

- All models that have been presented and discussed at Volpe and the FMCSA, are the result of years of research, experiences with the usage of the models, further refinements and fine-tuning and improvements by means of additional research. With this study for the IVW, we are at the beginning of building and using a monitoring system for the safety performance of motor carriers in the Netherlands and the effectiveness of the inspectorate.

- With the design and development of a first monitoring system in the Netherlands it is important that the instrument is transparent and that the definitions of what is included and excluded as well as the objectives of the system are clear. Furthermore it is important that these decisions are made in consultation with all relevant stakeholders. Typical for the developments in the US is that it initially began on a simple and small-scale basis (in 4 States initiated by the States themselves) and eventually been developed into a full range of consistent models and instruments that are widely applied by the organizations responsible for safety enforcement. The development of a monitoring system with many internal and external stakeholders (e.g. RDW, KLPD) and many different types of (possibly inconsistent) data will slow down the progress of developing and implementing a system. Important is that the interests of the stakeholders and the acceptance of a monitoring instrument are related to the period of time needed for development and the tangible / visible advantages that a system produces.

- The first step in the Netherlands is the design and development of a monitoring system like Safestat that will provide individual safety scores for motor carriers. When this system is in place and has been used for some time, the effects of CRs and roadside inspections can be determined by developing similar models to for instance the intervention model and CRIAM in the US. The current research questions concern both the aspects of monitoring as well as estimating the effectiveness of enforcement activities. A proposal for a time schedule is needed which places the conclusions of this study in a time perspective and provides an overview of the developments and initiatives and the relation between them for the coming years ahead.

- Possible preconditions for the development of a monitoring system are amongst others (these need to be discussed in sessions with stakeholders):
  - Including motor carriers that are established in the Netherlands as well as (foreign) motor carriers that make use of the Dutch motorway network and have been inspected (equal levels of competition for national and foreign carriers will increase the acceptance in relation to the Dutch motor carrier industry). Considering the high percentage of foreign freight vehicles on the Dutch motorway network this is an item for discussion that involves at least the Dutch motor carrier industry as well as the policy-making bodies of the Dutch Ministry of Transport.
  - Only freight vehicles are included with a gross vehicle weight exceeding 3500 kilograms (minimum weight as set in the 'Wet Goederenvervoer over de Weg');
  - Focus on the most unsafe carriers as well as the safest carriers(philosophy of enforcement: repressive versus preventive). Safe carriers can be benefited by

subjecting them to less frequent and less intense inspections and more free passages.

- For the design and development of a monitoring system, it is important to make full use of the implicit expertise and experience of the inspectors of IVW. For instance on the following questions:
  - Based on what factors and aspects do inspectors make a profile of an unsafe motor carrier?
  - What factors and elements are leading to determine whether a motor carrier, a vehicle or a driver is involved in violations and crashes or on the contrary show safe behavior: the so-called good and bad operators that determine the extremes in terms of safety in the industry?
  - What should the base set of information be that have to be collected from inspections (possible even by enforcement partners such as the police (KLPD))?;
  - Is standardization of inspections and data(bases) necessary?
  - What are possible causal relationships between for instance aspects and factors of freight transportation on the Dutch motorway network and the chances of being involved in a crash: for instance size of the motor carrier, new entrants, average fleet age, nationality of drivers etcetera?

- By means of work sessions with amongst others the inspectors of IVW, relevant factors and parameters can be determined or validated that are used today to identify unsafe operators. Also the identification of relevant data and data sources for the Safety Evaluation Areas of a monitoring system in the Netherlands is important in this respect. Furthermore the inspectors should play an important role in the estimation of weights and assumptions that have to be made. The outcomes are important input for the determination and development of for instance the *'safety evaluation area's*. Important is also to include the findings of DGG (for instance transport safety) as the choices made can be important for the future development and use of the models.

- Furthermore it is vital to start with the data that are already available with the IVW and other organizations such as the KLPD, RDW, NIWO, SIEV etcetera. The differences and similarities in the base sets of data between these organizations can be of great influence to the possibilities of developing a monitoring system in the Netherlands. The registration of the RDW is based on vehicles (license plate number) while the IVW registers on the basis of license holders.

For the monitoring system it is essential that as much as possible (available) data is used of (individually) performed inspections and crashes in order to get an accurate picture of the involvement of trucks, drivers, motor carriers in crashes. The KLPD keeps records of all types of violations and crashes involving fatalities or injuries that might be of great value to the development of a monitoring system. The IVW is, as far as is known, not aware of this data. The outcomes of individually performed inspections by other inspectorates (for instance the KLPD) are not available to the IVW at this stage. Therefore, it might be necessary to organize work sessions in which representatives from for instance the KLPD or the insurance industry participate.

# Appendix E: Report on visit to Volpe on 8-9 November 2001, Gerard de Jong, RAND Europe

On 8 and 9 November 2001 Koen de Groot and Pieter Wouters of the Transport Inspectorate Netherlands (TIN), Paul Huijbregts and Han van der Loop of the Transport Research Centre (AVV in Dutch) and Gerard de Jong of RAND Europe had a series of meeting at the Volpe Center, mostly with Dave Madsen and Don Wright of Volpe. Bill Lyons of Volpe was also present at some of the meetings. The topic for the discussions was the plan to develop in the Netherlands a selection instrument to make compliance reviews and or roadside inspections more effective, similar to SafeStat developed at Volpe, and to construct a tool for monitoring the effectiveness of TIN activities on road safety. AVV asked RAND Europe to work out the notes made of these discussions, which resulted in this memo.

**8 November 2001, morning**

First we were welcomed by the Volpe director Dr. John who gave a general introduction about the Volpe Centre and some of its major current projects. Volpe has about 500 federal employees and 700 contract support staff. It is a fee-for-services organisation: there is not a fixed budget for Volpe within the federal budget. At the moment there are major projects on transport security (especially after 11 September) and air traffic control (later on we also got to see a presentation on this). Volpe has also worked on conflict resolution (e.g. in specific cities) and traffic management for waterways. The goals for Volpe are not just to answer research questions on transport, but also to communicate those and to act as facilitator and catalyst in developments in transport.

After this, Pieter and Koen did a presentation about the TIN (printouts of the ppt file were handed out). They said that the TIN, unlike the FMCSA, does not do a technical inspection of the vehicle during a roadside inspection. Technical vehicle inspections on the roadside are done by national and regional police. Furthermore, vehicles are inspected annually (so-called 'APK' inspection). Nevertheless the scope of the TIN is broader than that of the FMCSA: the latter is responsible for traffic safety only, whereas the TIN also is responsible for market and working conditions in transport. In The Netherlands, there is a registration number at the TIN for hire and reward transport firms, but for own account transport operators there is a different system. The TIN can obtain information on traffic violations of a Dutch firm in for instance Germany, but it has to request this on a case-by-case basis. Foreign carriers need an international permit (issued by their home country) to operate in The Netherlands, just as Dutch carriers need an international permit issued by the TIN. The TIN also does roadside inspections of foreign trucks, but the registration of these inspections is rather limited. There is no regular exchange of information on violations by carriers between European countries.

Han and Paul did a presentation on the TIN monitoring project (printouts of the ppt file were handed out). Volpe asked whether it was possible to extrapolate the trend in the development of road fatalities in the figure presented to get the effects of policy. AVV mentioned 2 concerns w.r.t. the application of a SafeStat-like instrument in the Netherlands: 1) SafeStat focuses on the 25% unsafest carriers 2) it uses rankings not absolute scores. On 1 Volpe answered that SafeStat contains a lot of outputs on safe and unsafe carriers, only the final 'SafeStat score' is computed for the 25% unsafest on 2 or more SEA's. All carriers on which there is sufficient information are in SafeStat. The (original) application of SafeStat for the prioritisation of reviews focuses on the worst carriers, but the info is there for all groups and it can be used for other applications. Crash statistics are collected across the board and all firms can be in it. AVV is looking for a score measure that will be representative for the entire motor carrier population (especially for monitoring the effectiveness of safety policy). SafeStat uses motor carriers for which there is sufficient information. This includes many roadside inspections (2 mln a year), but fewer compliance reviews (10,000-12,000 motor carriers per year), because these are very labour-intensive (actually this is one reason for not doing these at random).

**8 November, afternoon**

Don and Dave presented SafeStat (file was sent later) and during this, many questions were asked.

SafeStat is about motor carriers. A motor carrier (MC) is anyone (own account or hire and reward) who operates a commercial motor vehicle (CMV), restricted here to the inter-state level (that's where FMCSA has jurisdiction). A CMV can be a truck (but must be >10,000 pounds) or a bus (> 12 persons, now maybe 8, can include minibus), scheduled or chartered. Publicly operated buses (e.g. buses operated by a municipality) are not included. There are in the US 500,000 – 600,000 motor carriers with a USDOT number. Some might have no trucks at all or have ceased to operate.

SafeStat started for OMC (now FMCSA), where there was dissatisfaction with the safety program. In prioritising MC's, OMC used to give safety ratings itself. These were determined in a rather ad hoc fashion. In developing SafeStat, Volpe used some concepts from earlier projects in other fields, Canadian experience and outcomes of stakeholder meetings. In the earlier stages of the project there were about 12 such meetings, with federal and state enforcers, trucking firms, shippers, insurers, safety lobby groups). The participants were asked to react to the current system, initial ideas for improvement, indicate what is important for traffic safety and how to measure this. In the morning there usually was a plenary meeting followed by discussions in about 5 group in the afternoon. Initially the idea of self-certification was tried out at these meetings, but this was abandoned since many did not like it.

One might say that the development method for SafeStat consisted of working from 2 directions: what is important (e.g. according to the experts) and what data exists?

Rankings or percentile scores (the second of AVV's concerns on SafeStat mentioned above) were used in SafeStat to make different variables within a SEA and different SEA's comparable: get them all on a 0-100 scale, but also to make the outcomes easy to understand. A ranking relative to your peers can readily be understood. Volpe also mentions that SafeMiles will be succeeded by the intervention model, in which some of the disadvantages and limitations of SafeMiles were taken into account. Pieter said that for some variables the 0-100 scale could be based on a large variation and for other variables, the same scale could be based on very limited variation. Volpe did not consider this, but what matters most is that the SafeStat outcomes were correlated with actual crash data (the SafeStat effectiveness study), with positive results.

Peer grouping is important because in the US there are large differences between MC's: many one-man-bands and a number of very big firms. In comparing crash rates one should therefore distinguish, e.g. between firms of different size classes. By comparing big firms with big firms, a big firm does not necessarily have a greater probability of inspection: only if it has high unsafety scores within the group of big ones. The peer groups are distinguished in such a way that each group has about the same total number of crashes. Gerard asked why some peer groups were based on variables that are not exogenous (such as firm size) but crash-related, such as number of violations or even crashes. Volpe answered that most firms in the peer group 2-3 crashes will be small. Therefore in practice, the problem mentioned will solve itself.

Safestat uses a data sufficiency criterion, to prevent that outcomes would be based on a too limited amount of data. The lowest acceptable number of data points (observations, e.g. number of accidents) for a variable in SafeStat, the data sufficiency criterion, is 2 or 3 (with 1 you can't even calculate a rate). Many small carriers will have 0 or 1 crash and will not be used in SafeStat. The ISS has a special rule for focussing inspections also on firms not yet covered in SafeStat..

On the question whether it would be possible to augment SafeStat to be useful for monitoring the development of safety (comparisons of aggregates of MC's over time), Volpe answered that they are working on a project to use SafeStat for this (just started): effectiveness measures based on SafeStat. This includes a cross sectional and a longitudinal study of SafeStat data (now over 4 years of data). In this project, Volpe will look at the absolute numbers from SafeStat.

SafeStat is updated (new scores on new data) every 6 months. This period is due to historical reasons. There were proposals for quarterly or even monthly updating. Running SafeStat takes a weekend. The input data are centrally stored and are being continually updated. FMCSA runs SafeStat, Volpe gets an extract and compares this against its own run. The software itself has been updated regularly.

If a firm changes its name and gets a new USDOT number, this should turn up at the field level. The SafeStat scores by MC are now publicly available through the Internet, and shippers and insurers are known to use these ratings. The sector (also the MC's) was supporting the publication on Internet.

The weights for importance, severity and time were based on outcomes of stakeholder meetings and field experience: field and enforcement staff were asked to comment on proposed weights and on the listing of firms by unsafety, based on initial trial weights.

SafeStat would probably never have emerged if it had to be developed as a US-wide system with all its present applications from the start. A key factor for success was that it was developed in a limited pilot in a few states first. The industry was involved from the beginning, got favourable experience in the pilot, and since then on SafeStat (use) has been expanding. The safety SEA is the most controversial part: crash data are not very reliable (roadside inspections are better and compliance reviews even better, but subjective). But, given the way SafeStat works, the carriers that are identified as bad, are very likely to be bad in reality, whereas other unsafe carriers may not be detected by SafeStat (type I versus type II errors).

Han asked about the representativenes of the group of carriers in SafeStat or with a SafeStat score. Volpe answered that every carrier has a non-zero probability to get in (e.g. through the crash statistics). About 80,000 MC's (of 500,000 – 600,000 with a USDOT) are in SafeStat. But these have about 80-90% of the power units: most big firms are covered. For safety policy it is no problem if small firms with no crashes would be missing.

The list of critical and acute violations used in SafeStat is in appendix B to the latest SafeStat report (8.3) and can be downloaded from the Volpe website (volpe.dot.gov/safestat/method). This also goes for the list used for hazmats in the fourth SEA. Koen thinks that in the Netherlands we might need a special SEA on hazmats (this is a policy priority issue). The TIN has data for this (from roadside inspections). Volpe says that the type of material will be an important distinction. Volpe did some work on this for prioritising shippers of hazmats.

The outcomes of the SafeStat effectiveness study are also in the reports (e.g. the one on SafeStat 7.0). This study confirms that SafeStat identifies carriers that have higher crash rates and confirms the weights of 2 and 1.5 used for the first and second SEA

**9 November 2001, morning**

First there was a meeting with John O'Donnell, division chief of the Office of System and Economic Assessment. He said that SafeStat and related instruments started on data available and are now driving data collection efforts. He also mentioned as success factors the small-scale start (and showing later on that it worked) and the involvement of the industry. SafeStat makes inspectors do their job better: they can show a firm is among the unsafest and on which data this is based. Sometimes this leads to correcting the data. SafeStat was an internal project for some time before it appeared on the Internet. The US is using some carrots now too: firms with good ratings can automatically pass some inspections ('green light').

Han asked why in ISS, SafeStat results and a variable indicating the amount of information available were combined into a single variable (with 3 categories), why not a two-way cross classification? Volpe answers that the roadside inspectors need an answer to the question 'stop the vehicle or not?" The variable on the amount of information available was added because of the other 10-20% of CMV's that is not covered in SafeStat: from this group CMV's need to be selected for roadside inspections too.

Han and Gerard also asked about the justification for the use of the figures 4.6% and 5.7% in SafeMiles (crash cause shares). Volpe admits there is no good justification. There was a review panel on SafeMiles. But SafeMiles has been abandoned in favour of second generation models, such as the intervention model.

The intervention model was presented by Dennis Bigelow, a colleague of Don and Dave. We'll get a copy of the presentation and of a more detailed presentation (if we have questions on these, Han will collect these and e-mail to Volpe). SafeMiles was only about the effects of roadside inspections, the intervention model adds traffic enforcement program (e.g. stopping vehicles for speeding, drunken drivers) effectiveness, including intra-state transport. It uses data for 1998/1999. The objective is to compute direct and indirect (deterrent) effects. The basic assumption is that an intervention (e.g. stopping a vehicle and taking away a defect) will reduce the number of crashes. Data on crash causation is missing. Some research for FMCSA on this is underway and can be used for the intervention model later on. In the absence of data, the intervention model uses the consensus of experts on transport and safety. In a study by Cycla Corp, industry experts rated many violations into risk categories (1 to 5). For other violations Volpe collected independent expert opinions. Now each of 900 violations have been assigned a risk profile (1 to 5). Per risk category there is an estimate of the number of violations that corresponds to one crash avoided. For the direct effect of roadside inspections and traffic enforcement the above information and inspection data is used to calculate the number of crashes avoided. The indirect effects are measured by comparing crash probabilities of the same carriers in year 1 and year 2, for carriers on which there is sufficient data on inspections and which improved. The difference is attributed to the inspections and enforcement. The number of crashes avoided (distinguishing direct versus indirect, roadside inspections versus traffic enforcement) is assigned to fatal, injured and towed away. The outcome is about 70 lifes saved (of about 4000 fatalities per year related to CMV crashes; this number is not just the truck drivers, but all fatalities).

A part of the roadside inspections is done at random: the 'fleet survey'.

Another recent project is the 'strategic plan', in which measures from SafeStat will be used to measure performance of the entire industry. Volpe can't say more on this now; the project is still being defined. Another study using SafeStat scores is the 'new entrants' study.

**9 November 2001, afternoon**

Rich Bates, MA State director of FMCSA, joined us. He also has previous experience in Connecticut. He said there was some initial resistance to SafeStat (some initial lists not accurate, but this was remedied by changing the input data with new information from the industry), but not anymore. The old compliance review prioritisation system was slow and not reliable. He thinks users of the end product should understand the system in general terms and the reason it exists. Now inspectors can go to those firms first that they can teach something on safety, which is more rewarding to them. ISS can not only be used at a fixed location, but with a laptop it's easier to do it from a fixed location instead of mobile. He underscores the importance of the gradual development and expansion of SafeStat. He has seen bad firms improving, but there are also firms that repeat being on the list. It's difficult to have an impact on the latter: Some simply refuse to pay the fines. Overall, he confirms that the industry likes SafeStat and think it is a good system (although room for improvement).

In the Netherlands the amount of time by which a driver exceeds the legal resting and driving limits is measured quite accurately, since in the Netherlands this is registered by the tachograaf, unlike in the US. This might be used in a selection or monitor instrument instead of recording whether there is a violation or not. Alternatively, the 'double standard' (violations in excess of 50%) could be used.

Volpe has read the RAND Europe Interim reports 1 and 2, but not in great detail. They will do so and let us know their comments, especially on the (interpretation) of US statistics. Volpe said comparing statistics from two countries is a difficult job, e.g. because of the definition of a crash (has changed in the US). The Netherlands has data from compliance reviews, roadside inspections and crash statistics too (because of the tachograaf even better data on some items). It must be possible to combine these in an instrument. One has to think about how to normalise data. Instead of USDOT numbers, there maybe other identifiers for firms (Pieter suggested Chamber of Commerce registration numbers). The effects of compliance reviews and roadside inspections should be determined separately. Educating carriers is not an activity of the TIN. Gerard mentions the possibility of developing a SafeStat-like instrument with different SEA's with quantitative measures only (e.g. in terms of crash probabilities), without a conversion to percentile scores. Volpe would like to mention in this respect that whatever the measure is, a better registration of crashes (more crashes reported, but just because of better measurement), should not result in a conclusion that roads are become unsafer and policies are ineffective. Volpe is not really afraid that the prioritisation in compliance reviews and roadside inspections (focussing on the unsafest) will lead to selective data collection and biassed measurements: ISS does not only use SafeStat and for compliance reviews SafeStat is not used to the extreme. Nevertheless there is a (potential) conflict between efficient spending of inspection and review budgets and getting an unbiased view on safety trends. The former however is regarded as far more important.

# Appendix F: Definitions and acronyms

## Definitions

Commercial Motor Vehicle (CMV): Any self-propelled or towed vehicle used on highways in intrastate or interstate commerce to transport passengers or property:

- if it has a gross vehicle weight rating of 26,001 or more pounds (11,794 kilograms).; or
- if it is designed to transport more than 16 passengers, including the driver; or
- if it is used to transport hazardous materials (as defined in 49 U.S.C. App. 1801 et seq.) in quantity requiring placarding under federal regulation

Driver: An occupant, who is in actual physical control of a transport vehicle; or, for an out-of-control vehicle, an occupant who was in control until control was lost

Gross Vehicle Weight (GVW): The maximum allowable fully laden weight of the vehicle and its payload. The most common classification scheme used by manufacturers and by states, often for both trucks and tractors.

Gross Vehicle Weight Rating (GVWR): A value specified by the manufacturer for a single-unit truck, track tractor, or trailer, or gross combined weight rating the sum of such values for the units which make up a truck combination. In the absence of a gross vehicle weight rating, an estimate of the gross weight of a fully loaded unit may be substituted for such a rating. The gross vehicle weight rating of a truck combination may be called the gross combination weight rating.

Hazardous Materials (HAZMAT or HM): A material or substance which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce and has been so designated.
This includes radioactive material, explosives, and poisonous materials.

Motor vehicle operator: person related to the road transportation sector, this includes supervisors, truck drivers, drivers-sales workers, bus drivers, taxicab drivers and chauffeurs, parking lot attendants and motor transportation occupations (NTS 2000).

Motor carrier vehicle: A truck, truck tractor or combination having a gross weight or registered gross weight in excess of 10,000 pounds.

Motor carrier: Any person or entity who is paid to transport property in their motor vehicle regardless of vehicle size or weight (For-hire carrier). Any person or entity operating a motor vehicle with a Gross Vehicle Weight Rating (GVWR) of 10,001 lbs. or more and which is used in the course of business to transport their own property (Own-account or Private carrier).

# Acronyms

| | |
|---|---|
| AVV | Adviesdienst voor Verkeer en Vervoer |
| CBS | Centraal Bureau voor de Statistiek |
| DGG | Directoraat-Generaal Goederenvervoer |
| FMCSA | Federal Motor Carrier Safety Admnistration |
| FARS | Fatality Analysis Reporting System |
| IVW | Inspectie Verkeer en Waterstaat |
| MCMIS | Motor Carrier Management Information System |
| MCP | Motor Carrier Permit |
| NIWO | Stichting Nationale en Internationale Wegvervoer Organisatie |
| NTS | National Transportation Statistics |
| NVVP | Nationaal Verkeers- en Vervoersplan |
| OVG | Onderzoek Verplaatsings Gedrag |
| PAP | Personen AutoPanel |
| SAFESTAT | Safety Status Measurement System |
| SIEV | Stichting Inschrijving Eigen Vervoer |
| TIN | Divisie Vervoer (within IVW) |
| TLN | Transport Logistiek Nederland |
| SEA | Safety Evaluation Area |
| AIM | Accident Involvement Measure |
| AII | Accident Involvement Indicator |
| DTRM | Driving Time Ratio Measure |
| DTRI | Driving Time Ratio Indicator |
| VDTRM | Violations of Driving Time Regulations Measure |
| VDTRI | Violations of Driving Time Regulations Indicator |
| NOVRM | Number of Other Violations from Roadside Inspections Measure |
| NOVRI | Number of Other Violations from Roadside Inspections Indicator |
| NOVCM | Number of Other Violations from Compliance Reviews Measure |
| NOVCI | Number of Other Violations from Compliance Reviews Indicator |
| VLRM | Vehicle Load Ratio Measure |
| VLRI | Vehicle Load Ratio Indicator |
| SMVRM | Safety Management Violations from Roadside Inspections Measure |
| SMVRI | Safety Management Violations from Roadside Inspections Indicator |
| SMVCM | Safety Management Violations from Compliance Reviews Measure |
| SMVCI | Safety Management Violations from Compliance Reviews Indicator |
| SMVEM | Safety Management Violations from Enforcement Cases Measure |
| SMVEI | Safety Management Violations from Enforcement Cases Indicator |
| HMVRM | Hazardous Materials Violations from Roadside Inspections Measure |
| HMVRI | Hazardous Materials Violations from Roadside Inspections Indicator |
| HMVCM | Hazardous Materials Violations from Compliance Reviews Measure |
| HMVCI | Hazardous Materials Violations from Compliance Reviews Indicator |

## SafeStat acronyms

| | |
|---|---|
| AII | Accident Involvement Indicator |
| AIM | Accident Involvement Measure |
| CMV | Commercial Motor Vehicle |
| CR | Compliance Review |
| DII | Driver Inspections Indicator |
| DIM | Driver Inspections Measure |
| DRI | Driver Review Indicator |
| DRM | Driver Review Measure |
| DOT | Department of Transportation |
| EHI | Enforcement History Indicator |
| ESM | Enforcement Severity Measure |
| FMCSA | Federal Motor Carrier Safety Administration |
| FMCSR | Federal Motor Carrier Safety Regulations |
| HM | Hazardous Materials |
| HMR | Hazardous Material Regulations |
| HMRI | Hazardous Material Review Indicator |
| HMRM | Hazardous Material Review Measure |
| ICC | Interstate Commerce Commission |
| IRP | International Registration Plan |
| ISS | Inspection Selection System |
| IVW | Transport and Water Management Inspectorate (Inspectie Verkeer en Waterstaat), Transport Inspectorate Netherlands (Divisie Vervoer) |
| MCMIS | Motor Carrier Management Information System |
| MCSIP | Motor Carrier Safety Improvement Process |
| MVI | Moving Violation Indicator |
| MVM | Moving Violations Measure |
| OOS | Out-of-Service |
| PRISM | Performance and Registration Information Systems Management |
| RAI | Recordable Accident Indicator |
| RAR | Recordable Accident Rate |
| SafeStat | Motor Carrier Safety Status Measurement System |
| SEA | Safety Evaluation Area |
| SMRI | Safety Management Review Indicator |
| SMRM | Safety Management Review Measure |
| VII | Vehicle Inspection Indicator |
| VIM | Vehicle Inspection Measure |
| VMT | Vehicle Miles Traveled |
| VRI | Vehicle Review Indicator |
| VRM | Vehicle Review Measure |

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