CALIFORNIA PATH PROGRAM
INSTITUTE OF TRANSPORTATION STUDIES
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# Applying Safety Improvements to Fleet Vehicles

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# APPLYING SAFETY IMPROVEMENTS TO FLEET VEHICLES

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CALIFORNIA PATH

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Setting New Directions in Traffic Safety

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# EXECUTIVE SUMMARY

The safety of both employees and the motoring public is of paramount importance to Caltrans, resulting in a continuing effort to improve the operating vehicle fleet. The potential safety changes that are the focus of this project are those that involve safety equipment enhancement over and above the original specifications for the vehicle or outside of the scope of the original equipment design or purpose, such as rear view backup video cameras.

The motivation for this project was Division of Equipment (DOE) managers' need for an objective strategy to address safety equipment deployment issues. These include determining where equipment changes should be made, whether statewide or only in specific locations, what types of vehicles will be involved, and how the changes should be made, for example, immediately retrofitting certain vehicles or changing the specifications for future vehicles.

Neither question needs to be answered on an absolute basis; for example, it may be appropriate to immediately retrofit particular vehicles in certain locations while changing the specifications for new vehicles to be deployed in other locations. Additionally, the problem may have non-equipment solutions such as changes to policies and procedures.

Our goal is to devise a system to assist DOE personnel in determining the magnitude and setting of safety problems as well as answering the key deployment questions. The method we will use is a nine-step process termed the **FLEET SAFETY EVALUATION TOOL (FSET)**. The nine steps are:

## STEP 1: PROBLEM IDENTIFICATION

A safety problem can come to the attention of the DOE from a number of different sources both inside Caltrans, such as equipment operators, and outside, such as vendors. Active surveillance of data in the Safety Information Management System (SIMS) resulting in monthly or quarterly reports is an excellent means of spotting emerging problems and trends.

## STEP 2: PROBLEM EVALUATION

Once a potential problem has been identified, it must be reviewed with an eye toward answering six questions:

1. What is the magnitude of the problem in terms of the number, distribution, and severity of incidents?
2. Is there more than one means to solve the problem; is the problem amenable only to an equipment solution or should it be solved with some combination of equipment, policy and procedural changes?
3. Is the problem related to vehicle working environment? The safety issue in question may be related to where the vehicle is being operated such as a mountainous area versus a desert area.
4. Is the problem statewide? In addition to the immediate environment issues, what is the geographical distribution of the incidents?
5. Is this a recent problem or one that has been occurring for some time?
6. Are there legal issues associated with the potential solutions? Will a potential solution increase Caltrans' exposure to litigation?

## STEP 3: SOLUTION IDENTIFICATION

Similar to the identification of the initial problem, solutions can come from both inside and outside sources. Additionally, the solution or solutions may be hardware, or changes to policies and procedures as well as some combination of these.

## STEP 4: SOLUTION EVALUATION

Once a set of potential solutions has been identified, they must be evaluated using vehicle crash data from SIMS, and a benefit/cost analysis. The output will be a benefit/cost matrix of solutions linked to different vehicles and locations.

## STEP 5: PILOT TESTING

In this step, the reduced feasible solution set from Step 4 is evaluated in the field. The objective of the test is to determine how effective a proposed solution is in addressing the identified problem. The findings from the pilot test can be used to further reduce the set of candidate solutions that will be examined in more detail during subsequent steps.

## STEP 6: STRATEGIC PLANNING FOR DEPLOYMENT

The strategic deployment plan is developed to provide guidance for implementing the solution or solutions that made it through the pilot testing stage and include recommendations regarding timing, location, and specific vehicles.

## STEP 7: DEPLOYMENT

In this step, the deployment plan from Step 6 is carried out and the solution(s) is(are) deployed.

## STEP 8: FOLLOW-UP EVALUATION

The procedures in this step will be similar to those carried out during the pilot testing phase and might consist of identification of performance measures, data collection, and finally some form of statistical analysis. The main difference between this step and the the pilot test is that the pilot test customarily is on a small scale whereas the full-fledged deployment evaluation is not.

## STEP 9: MODIFICATION OF SOLUTION

In this final step, the results of follow-up evaluation may be used to modify the deployment of the solution or solutions.

# INTRODUCTION

Caltrans currently operates more than 13,800 vehicles over 16,542 centerline miles (2003) of state highway involving a system divided into twelve districts with extensive variation in geography, weather, road type, and population and traffic density. These vehicles range from Class 1 cars, through Class 8 trucks and their use varies by type, district, time of year, and other factors. For the most part the Caltrans fleet is purchased, deployed, and maintained by Caltrans Division of Equipment (DOE), although some of the vehicles are rented and maintained by third parties.

The safety of both employees and the motoring public is of paramount importance to Caltrans, resulting in a continuing effort to improve the operating vehicle fleet. While fleet specifications are set by headquarters, individual vehicles are maintained and frequently enhanced by local DOE shops. In establishing specifications, the DOE is required to ensure that all vehicles meet state and national safety standards. Since changes made locally have the potential to affect a vehicle's ability to meet those standards, the DOE must maintain oversight of all repairs and modification of fleet vehicles. Additionally, given the similarities between many equipment types across districts, all DOE shops should be made aware of modifications made to vehicles at other DOE shops so that they can apply lessons learned elsewhere. For these reasons, any changes that are considered safety related, are, by Caltrans policy, to be evaluated by DOE.

This report will examine the current evaluation process and suggest a step-by-step approach based on data analysis that can be used by DOE managers in making safety equipment changes to fleet vehicles.

# PROJECT SCOPE AND MOTIVATION

This project focuses on safety equipment enhancement above and beyond the original purpose or specifications for the vehicle. Two examples are rear view backup cameras and seat headrest modifications. Safety changes that are not included are manufacturer recalls and those involving defective equipment or parts, such as defective hand rails and steering-box bolts. These are the responsibility of the manufacturer and should be corrected as soon as possible on all affected vehicles.

## THE RESULTS AND CONCLUSIONS OF THIS STUDY ARE BASED ON INFORMATION OBTAINED FROM THE FOLLOWING SOURCES:

**INTERNAL INTERVIEWS** These interviews were administered based on, but not limited to, a six-page survey (Appendix A) covering five major topics:

- Background Information
- Policies and Practices Regarding Vehicle Safety Improvement
- Equipment Being Used
- Vehicle Safety Instructions and Training
- Current Trends and Emerging Issues

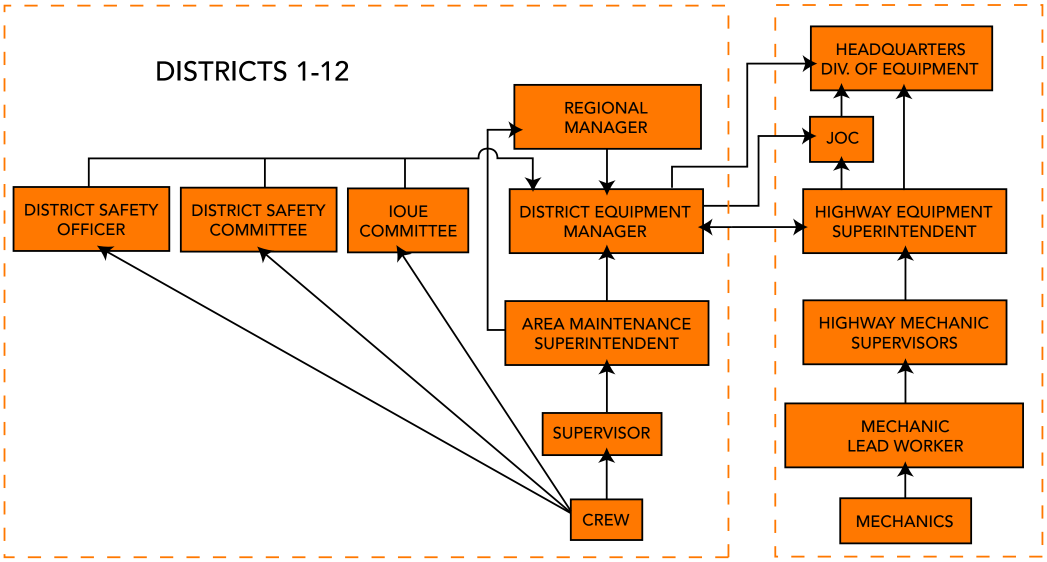
Interviews were conducted with the District Equipment Manager (a district employee) and the Highway Equipment Superintendent (a DOE employee) in districts 3, 4, and 5 (Figure 1).

**EXTERNAL INTERVIEWS** Based on the same questionnaire as the internal interviews, these involved representatives of three private companies and two other state departments of transportation (DOT) which, like Caltrans, operate a wide variety of vehicle types in settings exposed to extensive work and public vehicular traffic. The private companies were Granite Construction, Teichert Construction, and Pacific Gas & Electric. The two state DOTs were Arizona and Colorado.

**DATA ANALYSIS** Crash and injury data were obtained from Caltrans' Health and Safety Services' Safety Information Management System (SIMS) and include information on crash date, location, vehicle type, crash cause, and estimated cost. While the SIMS system contains a wealth of useful information, numerous areas lack sufficient detail to allow accurate cause-and-effect analysis. Additionally, even when such categories are present in the system, much information is missing or incomplete. For example, the category of crash costs includes only preliminary estimates of vehicle repair expenses and is not updated with actual figures after the repairs take place. Also, 38% of the listed crashes have an estimated cost of zero or the field has been left blank.

## Figure 1

**CALTRANS' ORGANIZATION AND INFORMATION FLOW**




This project was motivated by DOE managers' need for an objective strategy to address safety equipment deployment issues once it has been determined that there is a problem and that a feasible **EQUIPMENT** solution exists. The two key deployment issues facing DOE managers are:

### 1 WHERE SHOULD THE EQUIPMENT CHANGE BE MADE?

- Is the particular problem one that is encountered throughout the state or only in specific locations?
- What types of vehicles are involved?

### 2 HOW SHOULD THE CHANGE BE MADE?

- Immediately retrofit appropriate vehicles?
- Change specifications for new vehicles?

Neither question needs to be answered on an absolute basis; for example, it may be appropriate to immediately retrofit particular vehicles in certain locations while changing the specifications for new vehicles to be deployed in other locations. Additionally, the problem may have non-equipment solutions such as changes to policies and procedures.

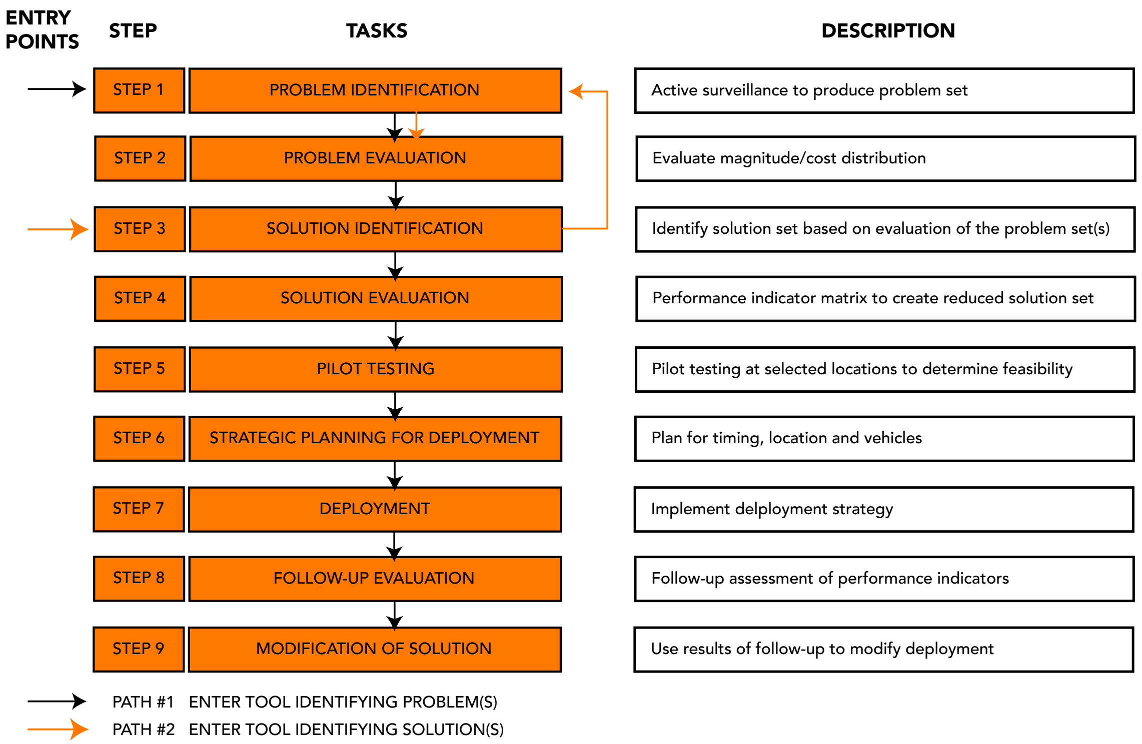
Our goal is to devise a system to assist DOE personnel in establishing the magnitude and setting of a safety problem as well as answering the key deployment questions. The method we will use is a nine-step process termed the **FLEET SAFETY EVALUATION TOOL**, which will be examined below and demonstrated using data from backing crashes.

# THE FLEET SAFETY EVALUATION TOOL (FSET)

The FSET (Figure 2) is a nine-step process that begins with the presentation of a problem and ends with the successful implementation of a solution or solutions. Each of the steps will be presented with its input sources, the action process, and the output.

Figure 2

**FLEET SAFETY ENHANCEMENT TOOL**



# STEP 1

## PROBLEM IDENTIFICATION: ACTIVE SURVEILLANCE TO PRODUCE PROBLEM SET

**INPUT**

- Employees
- HR/Safety
- Management
- Vendors

**PROCESS**

- Tailgate Meetings
- Local Requests
- Quarterly Data Report
- Merit Award

**OUTPUT**

- Problem Set

Safety problems can come to the attention of the DOE from different sources.

For **EMPLOYEES**, these are often initiated at the work crew level where they are brought up in a "tailgate" meeting. These meetings, between a work crew and their immediate supervisor, take place every ten working days and are designed to promote workplace safety as well as to provide a venue for raising concerns or making requests. In addition, employees can make suggestions through a formal process called a Merit Award, which carries with it the potential for financial compensation if an idea is implemented, though this process is not widely used.

When requests originate with the **END USER**, it must be determined whether the request actually involves a safety item or merely falls into the comfort/convenience/personal preference category. Generally, the district equipment manager will be the first to make this assessment. If it is found not to be a safety issue, it will be sent back to the originating program where a decision can be made whether or not to make the change, paid for out of the program's own funds. If safety-related, it will be passed up the line in the form of a "local request" (LR) to the Office of Engineering & Production Services, where the final conclusion will be made. At any step along the way a "non-safety" determination can be appealed by the originating party.

A suggestion or request can also originate from within the **HUMAN RESOURCES/SAFETY DEPARTMENT** or from managers anywhere within Caltrans. Concern regarding a particular problem or idea may result from the review of quarterly SIMS accident and injury reports, pertinent research reports, trade journals, or information from equipment managers' associations such as the Western States Highway Equipment Managers (WSHEM) association.

Regardless of the source, once a safety-related problem has been brought to the attention of the DOE's Office of Engineering and Production, it must be evaluated to determine what, if any, action should be taken.

# STEP 2

## PROBLEM EVALUATION: EVALUATE MAGNITUDE/COST/DISTRIBUTION

**INPUT**

- HR/Safety
- Management
- Vehicle Accident Database
- Legal Department

**PROCESS**

- Analysis of Vehicle Accident Database
- Management Knowledge

**OUTPUT**

- Reduced Problem Set With Problem Characteristics

### THE REVIEW PROCESS INVOLVES ANSWERING THE FOLLOWING SIX QUESTIONS:

### QUESTION 1
WHAT IS THE MAGNITUDE OF THE PROBLEM?

The first step is to determine if and to what degree a problem exists. SIMS data must be reviewed to find out:

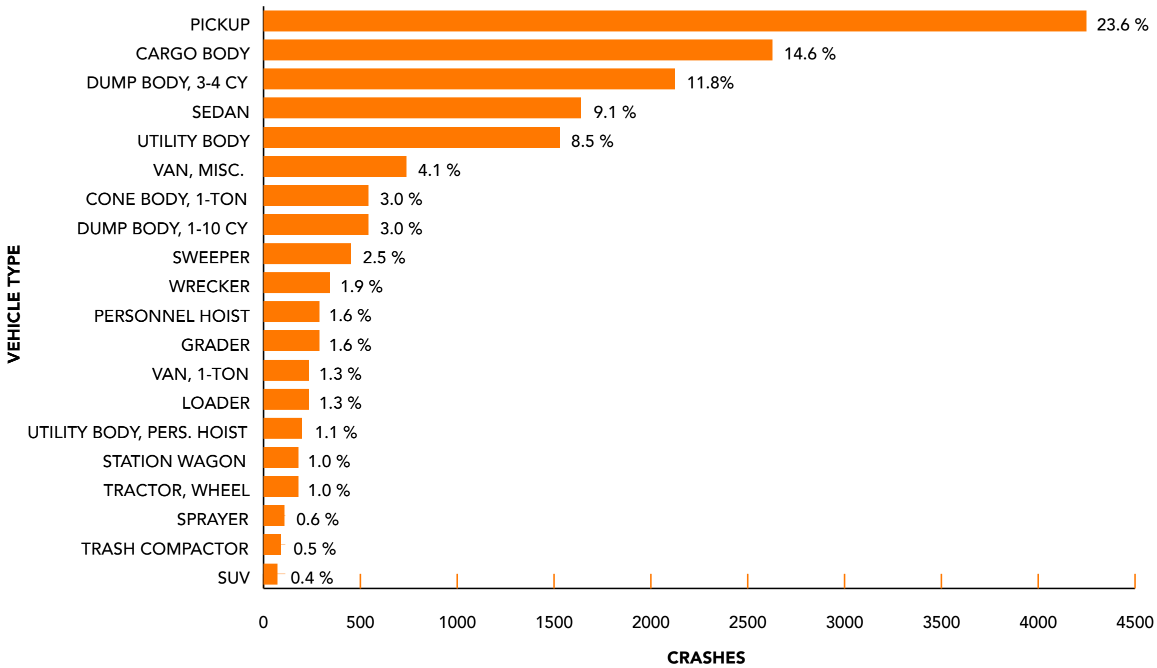
- How many incidents there are of this type
- How are the incidents are distributed:
  - by vehicle type
  - by geographical location (broken down by district at a minimum)
- How many deaths and injuries are involved
- The cost of injuries and property damage

A query tool is being developed to allow users to obtain this type of information by entering desired sesearch parameters such as district or vehicle type.

An example of the type of information available to decision-makers from the SIMS database is shown in Figure 3 which lists total number of crashes by equipment type, for the period 1992-2004.

# Figure 3

## CRASHES BY VEHICLE TYPE 1992-2004




SOURCE: Caltrans SIMS Database

## QUESTION 2

### IS THERE MORE THAN ONE METHOD TO SOLVE THE PROBLEM?

Although the problem is under consideration by the DOE, it may very well be that the solution lies, at least in part, in changes not associated with equipment modification. These could include alterations to current policies and procedures. Changes to policy would cover such areas as:

- Training
- Better Enforcement of Current Rules and Procedures
- Consequences for Not Following Rules

Procedures often vary by vehicle type and operation. For backing problems, these could include:

- Avoiding Backing Situations
- Requiring Spotters
- Requiring Use of Cones

In most cases the solution will turn out to be a combination of equipment modification and changes to policies and procedures.

## QUESTION 3
### IS THE PROBLEM RELATED TO VEHICLE WORKING ENVIRONMENT?

The safety issue in question may be related to where the vehicle is operated. For example, the same piece of equipment may be safe in a rural area but not when operated in a more confined urban environment. Other operating environment factors that could affect the safety record of a vehicle include:

- Mountain versus Desert
- Wet versus Dry
- Heat versus Cold

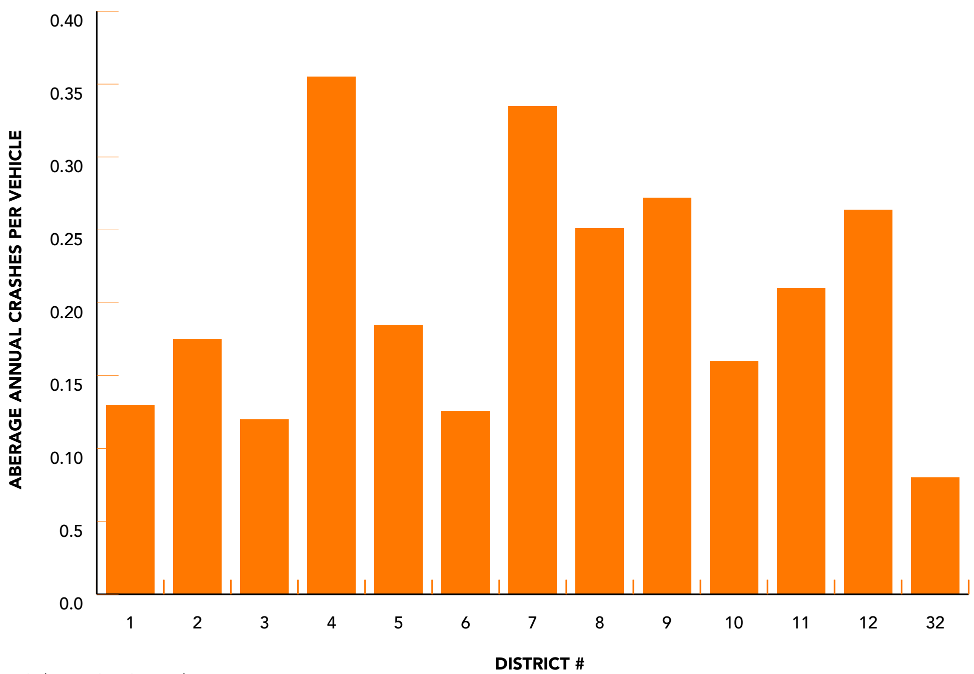
## QUESTION 4
### IS THE PROBLEM STATEWIDE?

In addition to the immediate environment issues, how are the incidents distributed geographically? Is the problem more prevalent in one district than another? If so, how does this district differ from the others?

In Figure 4, for example, the average annual crash rate for cargo-body vehicles in District 4 is almost three times that of District 6. While it may be that vehicle usage (in miles or hours, neither of which is currently available in the SIMS database) may be substantially higher in District 4, other factors such as operating procedures and working environment may also be responsible. Further investigation would be warranted before any action was taken.

Figure 4

**AVERAGE ANNUAL NUMBER OF CARGO-BODY VEHICLE CRASHES BY DISTRICT 1999-2004**




SOURCE: Caltrans SIMS Database

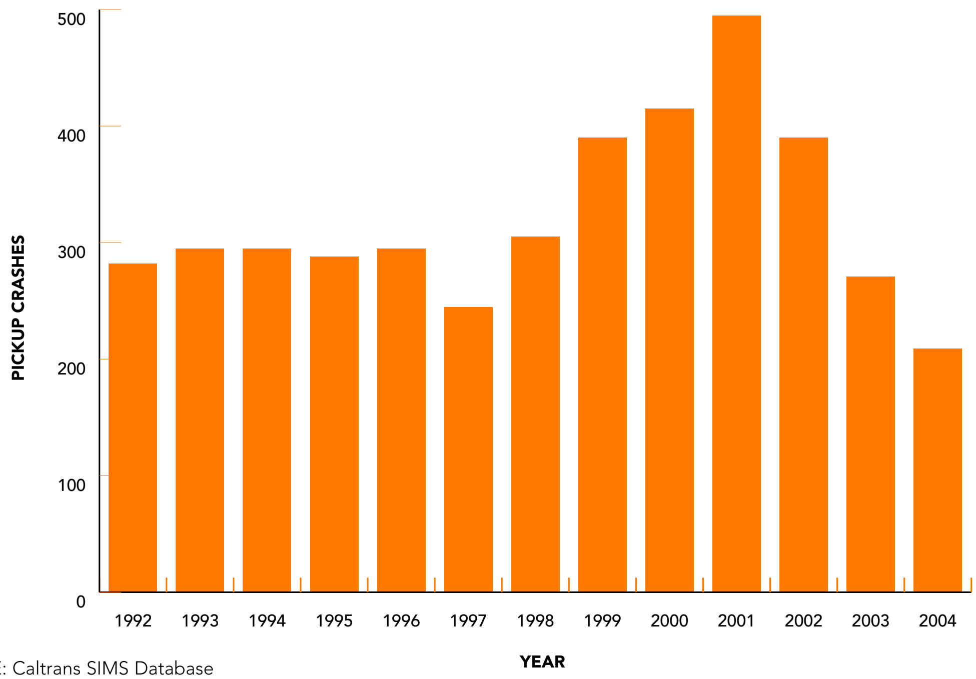
## QUESTION 5

### IS THIS A NEWLY OBSERVED PROBLEM OR ONE THAT HAS BEEN OCCURRING FOR SOME TIME?

The time frame of the safety issue is important because it may point to changes instituted at the time of the increase in incidents or the introduction of a new or modified piece of equipment. In Figure 5 the number of pickup-truck crashes is shown. There is a steady rise, peaking in 2001 and then declining rapidly through 2004. While pickup crashes continue to be the most prevalent type of crash (tenth when considering crashes per vehicle of that type) it would be beneficial to learn why the number of crashes declined by half between 2001 and 2004.

Figure 5

NUMBER OF PICKUP CRASHES BY YEAR 1992-2004




SOURCE: Caltrans SIMS Database

## QUESTION 6

### ARE THERE LEGAL ISSUES ASSOCIATED WITH THE POTENTIAL SOLUTIONS?

There is a widely-held belief among public agency decision-makers that implementation of safety-related measures can, unless universally applied, expose the agency to liability lawsuits. Whether it is the upgrading of warning devices at rail-highway intersections, the installation of a guardrail along a highway, or adding safety equipment to fleet vehicles, this is often cited as a reason not to act.

There is no doubt that we live in a litigious environment and that lawsuits, regardless of merit, are a costly fact of life. Public plaintiffs can—and do—argue that the addition of a safety device is a tacit admission of the existence of a dangerous condition and that installing such a device in one location and not in another constitutes negligence on the part of the agency. But this can be successfully countered by showing that there is a valid reason that the device was not universally applied (lack of sufficient resources being a strong one) and that the locations or vehicles where it was applied were chosen as a result of a careful, conscious, deliberate process.

The key argument here is that doing something is better than doing nothing. For example, it could just as easily be argued that the agency had the opportunity and resources to install the device in, say, half of the target locations or vehicles, with a potential 50 percent reduction in crashes, injuries, and deaths, but instead opted to do nothing.

While the above logic holds true for everyone, the case for at least partial installation is even stronger with regard to Caltrans' employees. If a worker were to be injured in a location or by a vehicle in which the device was not installed, the state would not be subject to liability in any event because of workers compensation, which is the exclusive remedy for an injured employee against his employer. There is a seminal case in which a CHP officer hit an icy patch of road and was seriously injured and sued Caltrans for dangerous conditions. The court held, however, that he was limited to workers compensation. So, as far as Caltrans is concerned, as to any claims made against it by its own people, it is insulated by workers compensation law.

# STEP 3

## SOLUTION IDENTIFICATION: IDENTIFY SOLUTION SET BASED ON EVALUATION OF THE PROBLEM SET(S)

**INPUT**

- Employees
- HR/Safety
- Management
- Vendors
- Network

**PROCESS**

- Review Existing Policies & Procedures
- Check Federal and Other State Resources
- Consult Network
- Review Literature

**OUTPUT**

- Potential Solutions

While some issues have a strictly "hardware" solution, for example, more efficient windshield wipers, others may involve a combination of operational as well as equipment changes. Caltrans' backing crashes, for example, have been determined to be 93% (SIMS) preventable by Caltrans' drivers. The drivers could have avoided these crashes by being more vigilant and by following current policy more closely. While stressing existing procedures such as avoiding backing situations, using a spotter where possible, and performing a walk-around check prior to backing up will go a long way in reducing such crashes, the addition of backing technology, including radar or video, has been shown to make a material difference within those companies that have adopted it, including two of those included in our external interviews: PG&E and Teichert Construction. This suggests a multi-solution approach.

The first step would be to examine existing policies, procedures, and training. Reducing exposure to dangerous conditions may simply require changing how the job is carried out. Current initial and refresher training policies should be examined for both rigor and relevance. Finally, if current procedures and policies appear to be adequate, enforcement may need to be increased. This introduces a point that was repeatedly brought up during interviews with Caltrans managers: the lack of meaningful consequences for policy violations and preventable crashes. It is of vital importance that a progressive discipline policy be established, communicated, and uniformly applied. Using backing incidents as an example, if a spotter was available but not used, the consequences should be greater than if a preventable crash occurs with no spotter available. If the potential spotter was a passenger in the vehicle, then he/she would also be held accountable. If safety expectations and consequences for non-compliance are made clear and applied in the same manner in all districts, there should be no grounds for complaint by employees who have been disciplined.

The next step would be to look to other government agencies or private companies that perform similar work in similar environments. There are a number of federal government agencies that could also be used as sources of data and research. Local universities could also be tapped on an as needed basis to review current literature regarding the problem.

There is a substantial amount of existing information which cannot be not found in published reports or on government websites. The key to accessing this information is networking. At the present time Caltrans is a member of the **WESTERN STATES HIGHWAY EQUIPMENT MANAGERS (WSHEM)** association which was established in 1967 to promote and encourage information and technology transfer through member states and related agencies. It is an informal organization that holds a conference once a year in one of the member states and is a networking group that discusses and disseminates information from general topics such as basic policy issues, politics, staffing, and business practices to specific items such as the best truck to perform a specific task. WSHEM has no website, newsletter, or other official communication.

A potential model for a more formal organization is the **NORTH AMERICAN ASSOCIATION OF TRANSPORTATION SAFETY AND HEALTH OFFICIALS** which was created as a vehicle to disseminate safety and health best practices among member state DOTs. If a state DOT is having a specific problem, other member DOTs can be queried about whether they have experienced similar problems or have recommendations for solutions. Their website (http://www.naatsho.org/) can be used for posting questions, new and interesting technologies, best practices, and innovative ideas. Sponsoring such an organization could be advantageous to the Caltrans DOE.

Additional solution sources are employees, via tailgate meetings, district safety meetings, and the joint operations committee, and vendors. Commercially available equipment solutions can be found in trade journals and by visiting vendor exhibitions at conferences.

# STEP 4

## SOLUTION EVALUATION:
## PERFORMANCE INDICATOR MATRIX TO CREATE REDUCED SOLUTION SET

**INPUT**

- Potential Solution Set From Step 3
- Vehicle Crash Data
- Solution Effectiveness Database
- Capital & Maintenance Expenses

**PROCESS**

- Benefit/Cost Analysis
- Performance Indicator (PI) Analysis

**OUTPUT**

- PI Matrix

The primary means of evaluating various countermeasures and deciding if and where they should be applied is the **BENEFIT/COST ANALYSIS (B/C RATIO)**. This will be performed utilizing the following three steps:

### 1 CALCULATE THE **POTENTIAL ANNUAL BENEFIT** FOR A SAFETY IMPROVEMENT:

**Benefit = (AvgFreq x Eff) x AvgIncCost**

where:

**AvgFreq** = average annual number of incidents

**Eff** = effectiveness of the upgrade

**AvgIncCost** = average cost of this type of incident

### 2 CALCULATE THE **TOTAL ANNUAL COST** FOR A SAFETY IMPROVEMENT:

**AvgCost = (InitCost/ExpLife) + AvgMaint**

**TotCost = AvgCost x NumInstall**

where:

**AvgCost** = average expected annual cost per installation

**InitCost** = initial cost to purchase & install one unit

**ExpLife** = expected life of unit in years

**AvgMaint** = average annual maintenance cost

**TotCost** = total annual cost for all units installed

**NumInstall** = number of units installed

## 3 CALCULATE BENEFIT/COST RATIO:

### B/C = Benefit/TotCost

where:

**B/C** = benefit/cost ratio

**Benefit** = potential annual benefit

**TotCost** = total annual cost for all units installed

By performing this analysis for each combination of equipment, vehicle, and location we will have a matrix of B/C ratios that will help to decide both:

### 1 WHERE EQUIPMENT CHANGES SHOULD BE MADE

- Should implementation be statewide or local?
- What types of vehicles are candidates for change?

### 2 HOW EQUIPMENT CHANGES SHOULD BE MADE

- Immediately retrofit appropriate vehicles?
- Changes to specifications for new vehicles?

Neither of these two questions needs to be answered on an absolute basis as incidents and their potential solutions differ widely.

There are a number of deficiencies in the SIMS database that make this analysis difficult. Cost estimates in the database, for example, are only initial estimates. Once repairs are completed the original estimates are not updated. Also, the estimate covers only repairs to the Caltrans vehicle involved. Other property damage is not included. Finally, only 52% of the vehicle incidents in the database have cost estimates.

Another vital piece of missing information involves personal injuries resulting from the incident. While it may be possible to link injury claims by Caltrans workers in other parts of the database to the incident, there is no information available about other injured parties. At a minimum, the current motor vehicle accident form, PM-S-0270, (Appendix B) should be amended to include a section regarding the degree of injury to any person involved in the incident.

Table 1 is an example of a benefit/cost matrix resulting from analysis of backing crashes. It shows, on a district-by-district basis, what potential benefits could be achieved by installing rear view backup video cameras in four types of vehicles. This analysis was severely impeded by the limits of the SIMS data listed above and is therefore based solely on the initial estimates of property damage to the Caltrans' vehicle. The following assumptions were made:

1 Statewide backing crash vehicle damage estimate per crash (from SIMS):

- Cargo body: **$2897**
- Dump body: **$1810**
- Pickup: **$837**
- Utility body: **$873**

2 Cost to purchase and install video system: **$600**

3 Expected life of video system: **5 years**

4 Expected annual maintenance of video system: **$25**

Using these cost and limited benefits assumptions, it would appear that a backup video system would only make sense for cargo body vehicles in districts 9, 12, and 32. **This example is for illustrative purposes only.** Current estimates of costs to repair Caltrans vehicles are inaccurate and payments to third parties are not included. Adding these elements to the benefit side of the equation would greatly enhance the B/C ratio.

## Table 1

### BENEFIT/COST RATIOS FOR INSTALLATION OF BACKING VIDEO CAMERAS

| DISTRICT | CARGO BODY | DUMP BODY | PICKUP | UTILITY BODY |
|---|---|---|---|---|
| 1 | 0.36 | 0.26 | 0.54 | 0.11 |
| 2 | 0.21 | 0.27 | 0.13 | 0.07 |
| 3 | 0.40 | 0.18 | 0.05 | 0.09 |
| 4 | 0.75 | 0.53 | 0.12 | 0.179 |
| 5 | 0.39 | 0.21 | 0.15 | 0.21 |
| 6 | 0.61 | 0.25 | 0.06 | 0.17 |
| 7 | 0.72 | 0.25 | 0.12 | 0.11 |
| 8 | 0.70 | 0.32 | 0.09 | 0.14 |
| 9 | 2.03 | 0.32 | 0.27 | 0.00 |
| 10 | 0.23 | 0.20 | 0.31 | 0.15 |
| 11 | 0.32 | 0.36 | 0.14 | 0.16 |
| 12 | 1.22 | 0.47 | 0.13 | 0.18 |
| 32 | 1.07 | 0.44 | 0.09 | 0.05 |

# STEP 5

## PILOT TESTING

## PILOT TESTING AT SELECTED LOCATIONS TO DETERMINE FEASIBILITY

### INPUT

- Reduced Solution Set From Solution Evaluation (Step 4)
- Non-Caltrans' DOT Test Findings

### PROCESS

- Conduct Initial Field Test
- Assess System Performance

### OUTPUT

- Pilot Test Findings, Lessons Learned, Recommendations

In Step 5, field tests of a proposed solution or solutions are conducted to determine their potential effectiveness in addressing the particular problem. The findings from the **PILOT TEST**, and the subsequent system performance assessment, can be used to further reduce the set of candidate solutions that will be examined in more detail during later steps: Deployment (Step 7); Follow-Up Evaluation (Step 8); and Modification of Solutions (Step 9).

The output from Step 4 provides a reduced solution set that may consist of one or more equipment or non-equipment solutions. This reduced solution set provides input for the pilot test. Another source of input for the test is results of tests conducted in other states by other Departments of Transportation.

Initial field or pilot tests are customarily small in scale and duration due to concerns regarding use of potentially limited resources, including labor, to evaluate the performance of potentially many different solutions, some of which may be eliminated or modified based on the findings of the pilot test.

First the test **LOCATION** for each element of the reduced solution set must be determined. If, based on prior data collection and analysis, the problem is found to be limited to a single Caltrans district or part of one district, the initial field test will occur in this same district. If the problem is more widespread, however, and/or is distributed throughout multiple districts or perhaps statewide, then budgetary constraints and data availability will play a major role in determining where to conduct the field test.

Next to be considered is the **DURATION** of the test. Although budgetary concerns may limit the duration, the trial must be of sufficient length to capture adequate specific performance data in order to generate statistically significant comparisons with data collected prior to the implementation of the potential solution. Using a before-and-after methodological approach, the frequency of the problem being studied, as well as the location and number of vehicles involved must be taken into account when determining the duration of the test. The specifics of particular cases may render field testing difficult or impossible. For example, if the problem occurs an average of several times per week in a single Caltrans district with a relatively small number of vehicles, then a pilot test can be readily implemented. However, if the problem occurs much less frequently, involves thousands of vehicles and/or is spread throughout the state, conducting a properly designed pilot test would be substantially more difficult and may not be possible at all.

The test should be designed so that the before-solution period and the after-solution period are similar to each other in as many characteristics as possible so that changes in performance measures may be attributed to the application of the particular solution.

## ASSESS SYSTEM PERFORMANCE

The objective of assessing system performance is to determine how effective a proposed solution is in addressing the problem it was selected to solve. To conduct this evaluation, a set of performance measures needs to be identified along with a determination of the availability of the appropriate data associated with these performance measures.

Typical performance measures include changes in the number of injuries and/or fatalities, changes in the severity of injuries, and user (vehicle driver) satisfaction. User satisfaction may be determined by means of surveys.

Ideally, each potential solution should be tested separately in order to accurately identify the result of each during the system performance assessment. However, the extent of resource limitations may require pilot testing of multiple solutions in a single testing environment.

Output from the system performance evaluation will include lessons learned and recommendations. The findings will include a comparative analysis of each of the candidate solutions in the reduced solution set, with comparisons between potential equipment solutions and comparisons between possible non-equipment solutions. Based on the findings of the pilot test, we may be able to eliminate one or more of the prospective solutions.

# STEP 6

## STRATEGIC PLANNING FOR DEPLOYMENT
## PLAN FOR TIMING, LOCATION, AND VEHICLES

**INPUT**

- Pilot Test Findings, Lessons Learned, Recommendations

**PROCESS**

- Prepare Deployment Plan

**OUTPUT**

- Planning Document for Deployment of Solution or Solutions

This section describes considerations involved in the development of a plan to guide the implementation of a solution or solutions to the identified problem. The output from the pilot test (Step 5) might include a recommendation to remove one or more elements from the reduced set of solutions (output from Step 4). We refer to this possibly modified set of solutions as the **STEP 5 SET OF SOLUTIONS**. As was the case in Step 4, the Step 5 set of solutions may be comprised of one or more equipment or non-equipment solutions and this set provides the input for step 6.

A **STRATEGIC DEPLOYMENT PLAN** is developed to offer guidance in implementing a solution or solutions to designated Caltrans fleet vehicle problems. The contents of a strategic deployment plan should cover the following related and inter-dependent topics:

- Implementers and Management
- Type
- Approach
- Location
- Timing
- Impacts
- Vehicles
- Operational Scenarios
- Funding Issues

**IMPLEMENTERS AND MANAGEMENT** Caltrans staff at both the district and headquarters levels will have roles and responsibilities in the deployment of the solution or solutions. Specific roles depend on where the solution is implemented, whether in a single district or in multiple districts, which in turn depends on where the problem was identified. The management of the deployment process, whether at the district level with a close-to-the-problem view or at headquarters with a broader perspective view, needs to include communication paths and means of coordination.

**TYPE** The solution to the identified problem will be equipment-related and/or non-equipment related. The equipment-related solution may involve the use of particular technologies, such as radar systems, for which a specific commercial product must be selected from possibly many alternatives. For non-equipment solutions, the focus is on policy or procedural changes likely due to driver-related problem causes. Such solutions may include enhanced driver training, additional staff to support the driver, and more stringent enforcement of driver regulations.

**APPROACH** The particular way a solution is executed depends on whether it is equipment- or non-equipment-related. If the solution is equipment-related, the primary questions is whether to implement the solution by retrofitting existing equipment, or by changing equipment requirement specifications to address the problem by acquiring new equipment. To help determine which of these two alternative strategies to select, implementers should consider the equipment turnover rate. If turnover is fast then it appears reasonable to change specifications for new equipment; if the rate is slow, then the retrofit route should be selected. However, implementers need to determine precise meanings of turnover speed.

**LOCATION** The solution may be implemented only where the problem was identified, which may be a single Caltrans district or part of a district, or it may be implemented on a statewide basis independent of where the problem occurred. If the problem is more widespread and distributed throughout multiple districts or statewide, then budgetary constraints and data availability will play a major role in determining where to deploy the solution; either in a single area or in multiple locations.

**IMPACTS** The deployment of the solution may have implications, legal, for example, other than addressing the identified problem. It is important to consider other consequences that may occur as a result of implementing the solution.

**VEHICLES** During the problem identification step (Step 1), the types of fleet vehicles affected by the problem are determined. Therefore, it appears reasonable to focus only on these vehicle types when implementing the solution. However, in cases wherein the problem and associated solution are equipment-related, there may be other vehicle types not associated with the particular problem, but which have the same equipment and could be vulnerable to the same problem in the future. Implementers must consider these alternatives carefully.

**OPERATIONAL SCENARIOS** Associated with each identified problem is the operational context in which the problem occurred. As part of the deployment of each solution to the problem, changes to the operational context should be considered. In particular, if deployment includes vehicle types not associated with the problem, should deployment also reflect operational scenarios for these other vehicle types or remain focused on vehicles directly affected by the problem?

**FUNDING ISSUES** There are numerous decisions involved in the course of implementing the solution to the problem. Each choice has a financial component that needs to be considered an integral part of the decision-making process. For example, trade-offs between budgetary constraints and the severity of injuries associated with a particular problem should be closely examined.

**TIMING** The scheduling for the start of deployment depends on the other issues being considered, including location, vehicle types, operational scenarios, funding issues, and potential consequences of deployment.

The output of this step is a planning document for the deployment of each solution to the designated problem as it was identified in Step 1.

# STEP 7

## DEPLOYMENT
## IMPLEMENT DEPLOYMENT STRATEGY

**INPUT**

- Deployment Planning Document

**PROCESS**

- Follow Guidelines in Deployment Planning Document

**OUTPUT**

- Deployed Solution or Solutions

The output from Step 6, the deployment planning document, provides the input for Step 7. The guidelines in the deployment planning document are to be followed and the solution deployed.

# STEP 8

## FOLLOW-UP EVALUATION
## FOLLOW-UP ASSESSMENT OF PERFORMANCE INDICATORS

**INPUT**

- Pilot Test Findings
- Planning Document for Deployment of Solution or Solutions
- Deployed Solution

**PROCESS**

- Use Before-and-After Methodology
- Identify Performance Measures
- Collect Data
- Analyze Data

**OUTPUT**

- Evaluation's Findings, Lessons Learned, Recommendations

Input for the follow-up evaluation consists of output from Steps 5, 6, and 7.

The follow-up evaluation procedures are similar to those described in Step 5: **1** use of before-and-after methodology, **2** identification of performance measures, **3** collection of data, and **4** data analysis. The main difference between the pilot test and the follow-up evaluation is that the pilot test customarily is on a small scale whereas the post-deployment evaluation is on a larger scale.

Output from the follow-up evaluation will include the study's findings, lessons learned, and recommendations. The findings consist of a comparative analysis of each of the deployed solutions to the designated problem. Recommendations comprise changes to the set of deployed solutions, such as elimination of one or more of the solutions from further consideration.

# STEP 9

## MODIFICATION OF SOLUTION
## USE RESULTS OF FOLLOW-UP TO MODIFY DEPLOYMENT

**INPUT**

- Evaluation's Findings, Lessons Learned, Recommendations

**PROCESS**

- Implement Recommendations From Follow-Up Evaluation

**OUTPUT**

- Modification of Deployment Strategy

The output from the follow-up evaluation consists of its findings, lessons learned, and recommendations, and serves as input for Step 9. The changes to the set of solutions indicated in the recommendations from the follow-up evaluation are implemented. Such modifications can range from no change all the way to eliminating all solutions from further consideration and starting the entire process over again. More typically, changes will fall between these two extremes, for example, a further reduction in the set of solutions that are deployed. The output of Step 9 is the final set of solutions to the designated problem.

# CONCLUSIONS AND RECOMMENDATIONS

## CONCLUSION

- Caltrans' fleet has a significant and costly collision history
- The DOE has a comprehensive system for addressing fleet safety
- Caltrans has determined that modifications to vehicles and procedures could further increease safety
- This report describes the **FLEET SAFETY EVALUATION TOOL (FSET)**, a nine-step approach to identify and evaluate vehicle safety enhancements

## RECOMMENDATIONS

- Expand SIMS data system resource potential by incorporating additional information categories into current data forms
- Include third-party collision costs
- Develop a computer-based implementation of the **FLEET SAFETY EVALUATION TOOL**

# APPENDIX A: SAFETY IMPROVEMENTS TO FLEET VEHICLES SURVEY

## BACKGROUND INFORMATION:

**1. Which State DOT or Company/Organization are you associated with?**

❏ California

❏ Oregon

❏ Washington

❏ Arizona

❏ Nevada

❏ Idaho

❏ Montana

❏ Colorado

❏ Utah

❏ Wyoming

❏ New Mexico

❏ Non-DOT Company/Organization

Please indicate the name of your company or organization:

______________________________________________________________________________

**2. How long have you been directly involved with safety within your organization?**

_____Years _____Months

**3. What is your job title and description?**

______________________________________________________________________________

**4. What is your role in determining the need for and design of vehicle safety improvements?**

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

**5. If you feel you can reasonably estimate the following, please answer:**

What is the size of your vehicle fleet? ____________________

What is the distribution of your fleet?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

How often are vehicles inspected? _________________

Policies and practices regarding vehicle safety improvement:

**6. Does you organization have a formal procedure for identifying vehicular safety problems?**

_____Yes _____No

IF "Yes", please outline that procedure:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

**7. Does you organization provide a means for employees to report safety problems?**

_____Yes _____No

Can this be done anonymously if the employee desires? _____Yes _____No

**8. Does you organization provide a means for employees to make safety related suggestions?**

_____Yes _____No

**9. How does your organization identify safety problems?**

____ Regular review of crash reports

____ Regular review of maintenance records

____ Regular driver interviews

____ Other. Please list:

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

**10. What is the procedure once a problem is identified?**
**(Please include information on solution identification, selection, and implementation)**

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

**11. How effective do you think these polices are in identifying safety problems?**

On the 1 to 10 scale below, please circle the number that you feel is most appropriate

| Very successful | | | | Somewhat successful | | | | Not successful | |
|---|---|---|---|---|---|---|---|---|---|
| 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |

**12. How effective do you think these polices are once a safety problems is identified?**

On the 1 to 10 scale below, please circle the number that you feel is most appropriate

| Very successful | | | Somewhat successful | | | | Not successful | | |
|---|---|---|---|---|---|---|---|---|---|
| 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |

**13. To what extent would you say your organization's vehicular safety policies are being followed?**

On the 1 to 10 scale below, please circle the number that you feel is most appropriate

| Very successful | | | Somewhat successful | | | | Not successful | | |
|---|---|---|---|---|---|---|---|---|---|
| 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |

**14. Does your organization have some means to determine if safety policies and procedures are being followed?**

_____Yes _____No

IF "Yes", please outline:

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

**15. Does your organization routinely collect safety related data?**

_____Yes _____No

IF "Yes", what types of data are collected and do you find this data useful?

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

**16. What safety related data that is not currently collected do you think should be collected?**

_______________________________________________________________________________

_______________________________________________________________________________

_______________________________________________________________________________

_______________________________________________________________________________

## EQUIPMENT BEING USED:

**17. Have you made any changes to your equipment to improve safety?**

_____Yes _____No

If "Yes," please list them and indicate if they have been effective:

_______________________________________________________________________________

_______________________________________________________________________________

_______________________________________________________________________________

_______________________________________________________________________________

_______________________________________________________________________________

_______________________________________________________________________________

_______________________________________________________________________________

_______________________________________________________________________________

_______________________________________________________________________________

**18. Are there any safety improvements would you like to have made but were unable to?**

_____Yes _____No

If "Yes," please list them and indicate why they were not implemented:

_______________________________________________________________________________

_______________________________________________________________________________

_______________________________________________________________________________

_______________________________________________________________________________

_______________________________________________________________________________

_______________________________________________________________________________

_______________________________________________________________________________

_______________________________________________________________________________

_______________________________________________________________________________

## VEHICLE SAFETY INSTRUCTIONS AND TRAINING:

**19. What kind of vehicle safety instruction and/or training do you provide and to whom is it provided? Please describe.**

_______________________________________________________________________________

_______________________________________________________________________________

_______________________________________________________________________________

_______________________________________________________________________________

_______________________________________________________________________________

_______________________________________________________________________________

_______________________________________________________________________________

_______________________________________________________________________________

_______________________________________________________________________________

**20. How effective is the training?**

On the 1 to 10 scale below, please circle the number that you feel is most appropriate

| Very successful | | | | Somewhat successful | | | | | Not successful |
|---|---|---|---|---|---|---|---|---|---|
| 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |

**21. What is the most effective part of the training? Least effective?**

_______________________________________________________________________________

_______________________________________________________________________________

_______________________________________________________________________________

_______________________________________________________________________________

_______________________________________________________________________________

_______________________________________________________________________________

_______________________________________________________________________________

_______________________________________________________________________________

## CURRENT TRENDS AND EMERGING ISSUES:

**22. Please describe any issues currently being addressed in your organization regarding improving vehicle safety:**

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

**23. How were these issues identified?**

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

**24. Please describe the procedure used for prioritizing vehicle safety improvements within your organization:**

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

**25. How successful do you feel the vehicle safety improvements that have already been implemented in your agency have been?**

On the 1 to 10 scale below, please circle the number that you feel is most appropriate

| Very successful | | | | Somewhat successful | | | | Not successful | |
|---|---|---|---|---|---|---|---|---|---|
| 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |

**26. How do you quantify the success or effectiveness of safety improvements? (For example: does the crash rate go down; is the benefit/cost ratio greater than one?)**

____________________________________________________________

____________________________________________________________

____________________________________________________________

____________________________________________________________

____________________________________________________________

____________________________________________________________

____________________________________________________________

**We appreciate the time and effort you put into participating in this survey.**

# APPENDIX B: CALTRANS MOTOR VEHICLE ACCIDENT FORM

STATE OF CALIFORNIA • DEPARTMENT OF TRANSPORTATION

**DATA INPUT FOR MOTOR VEHICLE ACCIDENT**

PM-S-0270 (REV. 5/95)

**CONFIDENTIAL**

*This document contains personal information and pursuant to Civil Code 1798.21 it shall be kept confidential in order to protect against unauthorized*

**ACCIDENT INFORMATION**
*(This Form to be completed by First Line Supervisor)*

| DATE OF ACCIDENT | TIME *(24 Hour)* | CALTRANS EMPLOYEE INJURED? ☐ Yes ☐ No<br>OTHER CALTRANS VEHICLE(S) INVOLVED? ☐ Yes ☐ No | ACCIDENT NUMBER<br>M - |
|---|---|---|---|

ACCIDENT DESCRIPTION *(Briefly describe Accident - Provide Details not included below)*

WAS A POLICE REPORT FILED? ☐ Yes ☐ No *IF YES, ENTER FROM TOP OF POLICE REPORT*** | N.C.I.C. # | OFFICER'S BADGE #

**EMPLOYEE INFORMATION**

| LAST | FIRST | MI | SEX | DATE OF HIRE |
|---|---|---|---|---|

| SOCIAL SECURITY NUMBER | BIRTHDATE | DRIVER LICENSE NUMBER | DRUG TEST *(Sensitive Positions Only)* ☐ Yes ☐ No |
|---|---|---|---|

| CLASS CODE | MTCE ACTIVITY NUMBER ☐ | EMPLOYMENT STATUS *(Check one)* ☐ PFT ☐ PI ☐ LT ☐ PPT ☐ TAU ☐ SPP ☐ RA ☐ SA ☐ †CE |
|---|---|---|

| DISTRICT NUMBER | UNIT/COST CENTER* | ITEM NUMBER | C-NUMBER | LICENSE NUMBER | ESTIMATED REPAIR COST |
|---|---|---|---|---|---|

**DETAILED INFORMATION**
*(Circle one appropriate for each Category)*

**A. WEATHER**
01 CLEAR
02 CLOUDY
03 FOG
04 RAIN
05 SNOW
06 WIND

**B. VISIBILITY**
01 OVER 1/2 MILE
02 LESS THAN 1/2 MILE
03 LESS THAN 100 YARDS

**C. ROAD CONDITION**
01 DRY
02 WET
03 SNOW/ICE
04 SLIPPERY (MUDDY, OILY, ETC)
05 NOT A FACTOR

**D. PREVENTABILITY**
01 BY DRIVER
02 NON PREVENTABLE
03 BY OTHER CALTRANS EMPLOYEE
04 BY CALTRANS MANAGEMENT
05 BY PRIVATE PARTY

IF 03 IS CIRCLED ENTER EMPLOYEE'S SOCIAL SECURITY NUMBER

**E. VEHICLES**
01 SOLO
02 TWO OR MORE MOVING VEHICLES

**F. TYPE OF VEHICLE**
01 STATE
02 PRIVATE
03 RENTAL

**G. VEHICLE FUNCTION**
01 EQUIPMENT
02 TRANSPORT PERSONNEL
03 TRANSPORT EQUIPMENT
04 TRANSPORT MATERIAL
05 SNOW REMOVAL
06 SHADOW
07 BARRIER
08 ADVANCE WARNING

**H. CRASH CUSHION**
01 HIT
02 NOT HIT
03 NOT APPLICABLE

**I. PROTECTIVE BELT IN USE**
01 LAP BELT
02 SHOULDER HARNESS
03 BOTH LAP BELT & SHOULDER HARNESS
04 NONE USED

**J. GENERAL LOCATION**
01 CITY STREET
02 CONVENTIONAL HIGHWAY
03 CONSTRUCTION
04 FREEWAY
05 FREEWAY RAMP OR CONNECTOR
06 LANE OR SHOULDER CLOSURE
07 PRIVATE PROPERTY
08 RURAL ROAD
09 STATE YARD OR PROPERTY
10 TUNNEL OR TUBE
11 MAINTENANCE WORK ZONE

**K. SPECIFIC LOCATION**
01 AT INTERSECTION
02 MEDIAN
03 OFF STREET OR HWY IN R/W
04 ON BRIDGE
05 PARKING LOT
06 SHOULDER
07 TRAVELLED WAY

**L. BASIC CAUSE**
**ST. OTH.**
01 01 EXCESSIVE SPEED
02 02 FOLLOWING TOO CLOSE
03 03 IN WRONG LANE
04 04 AVOIDING AUTO OR OBJECT
05 05 IMPROPERLY PARKED
06 06 IMPROPER BACKING
07 07 DISREGARD OF SIGNS, SIGNALS ETC.
08 08 FAILURE TO OBSERVE CONDITIONS
09 09 POOR JUDGEMENT
10 10 IMPROPER OPERATION OF VEHICLE
11 11 UNKNOWN
12 12 BLOCKED VISION
13 13 DEFECTIVE EQUIPMENT
14 14 LOST LOAD

**M. DRIVERS CONDITION**
**ST. OTH.**
01 01 NORMAL
02 02 DRUG/ALCOHOL IMPAIRED
03 03 ILL
04 04 SLEEPY OR FATIGUED
05 05 INATTENTIVE
06 06 OTHERWISE IMPAIRED

**N. MOVEMENT PROCEEDING COLLISION**
01 STOPPED
02 PROCEEDING STRAIGHT
03 RAN OFF ROAD
04 MAKING RIGHT TURN
05 MAKING LEFT TURN
06 MAKING U TURN
07 BACKING
08 SLOWING/STOPPING
09 PASSING OTHER VEHICLE
10 CHANGING LANE
11 PARKING MANEUVER
12 ENTERING TRAFFIC
13 EVASIVE MANEUVER
14 CROSSING INTO OPPOSING LANE
15 PARKED
16 MERGING
17 TRAVELING WRONG WAY
18 LOST CONTROL

**O. TYPE OF COLLISION**
01 HEAD ON
02 SIDESWIPE
03 HIT IN REAR
04 BROADSIDE
05 HIT OBJECT
06 OVERTURNED
07 VEHICLE/PEDESTRIAN
08 HIT REAR OF OTHER

**P. MOTOR VEHICLE INVOLVED WITH**
01 NON COLLISION
02 PEDESTRIAN
03 OTHER MOTOR VEHICLE
04 MOTOR VEHICLE ON OTHER ROADWAY
05 TRAIN
06 BICYCLE
07 ANIMAL
08 FIXED OBJECT
09 RUNAWAY VEHICLE

**Q. PEDESTRIAN INVOLVEMENT**
01 NO PEDESTRIAN INVOLVED
02 CROSSING- IN CROSSWALK
03 CROSSING- NOT IN CROSSWALK
04 WALKING ALONG ROADWAY

**R. ACCIDENT CLASS**
(SEE REVERSE FOR DETAILS)
01 I (a)
02 I (b)
03 II (a)
04 II (b)
05 II (c)
06 III

**S. OCCUPATION**
01 ADM -ALL OFFICE WORK
02 LAB - LAB TESTING, FIELD AND LAB
03 SHP - MECHANICS, WELDERS, ETC.
04 CON -FIELD CONSTRUCTION
05 SUR - FIELD SURVEYS
06 FTR - FIELD TRAFFIC
07 TOL - TOLL SERVICES
08 FMT - FIELD MAINTENANCE
09 SPP - SPECIAL PROGRAM PEOPLE
10 CEM -CONTRACTORS EMPLOYEE †

***ENTER THE UNIT NUMBER THE EMPLOYEE WAS CHARGED TO AT THE TIME OF THE ACCIDENT**

****THIS INFORMATION IS INCLUDED TO ENABLE COMPARISON OF SUPERVISOR'S REVIEW TO THAT OF LAW ENFORCEMENT OFFICER**

**† INCLUDED FOR TRACKING PURPOSES ONLY**

*This Form **must be certified** correct by the Safety Officer before Data Input* ☐ Certified correct O.K. for Data Entry

| SAFETY OFFICER'S SIGNATURE | ENTERED BY *(Initial)* | DATE |
|---|---|---|

# APPENDIX C: RECOMMENDED ADDITIONS TO CALTRANS' "DATA INPUT FOR MOTOR VEHICLE ACCIDENTS"

The information collected on vehicular accidents for the SIMS database should be amended to include the following additions as a minimum:

**INJURIES**

1. DRIVER
2. PASSENGER
3. OTHER VEHICLE DRIVER
4. OTHER VEHICLE PASSENGER
5. PEDESTRIAN

These would be listed using either the KABCO injury scale or the MAIS system.

**KABCO**

K - Fatal

A - Incapacitating injury

B - Non-incapacitating injury

C - Possible injury

0 - No injury

**MAIS: Maximum Abbreviated Injury Scale = severity of worst injury**

MAIS 0 : no injury

MAIS 1: minor injury: abrasion, laceration, broken finger

MAIS 2: moderate: simple broken bone, loss of consciousness

MAIS 3: serious: complicated fracture, concussion

MAIS 4: severe: massive organ injury, heart laceration

MAIS 5: critical: spinal cord syndrome, crushed limb

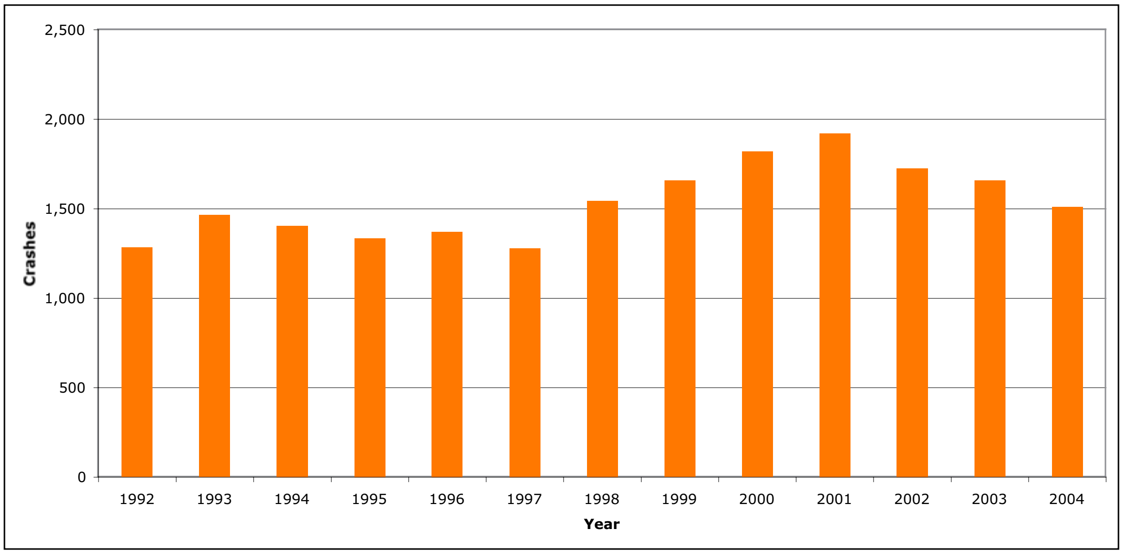
MAIS 6 : unsurvivable: crushed skull, chest

# APPENDIX D: FLEET SAFETY DATA REPORT

The first step of the Fleet Safety Evaluation Tool is problem identification. As discussed earlier, this may originate from within the human resources/safety department or from managers anywhere within Caltrans as a result of reviewing quarterly SIMS accident and injury reports

The data may be examined starting with general information and then working toward the more specific. While the following information does not exhaust all of the potential ways to look at the data, it does give a sense of what is available. Figure 1 shows the number of motor vehicle crashes from 1992 through 2004. Information on the number of vehicles during these years is not available so there is no way of knowing whether the changes in the number of incidents are due to changes in accident rates or merely reflect differences in the number of vehicles or miles driven. Data on vehicle numbers and usage have been requested and will be available for future reports.

### FIGURE 1: CRASH FREQUENCY BY YEAR



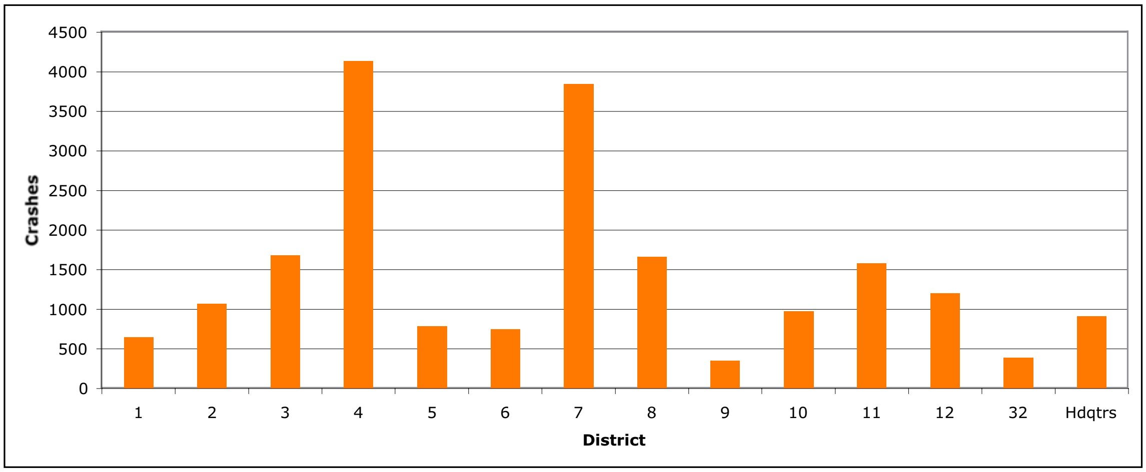

Next, motor vehicle incidents are examined on a district-by-district basis. Figure 2 shows the number of crashes in each district for 1992 through 2004. The data for the graph are not normalized for variations in numbers of vehicles or vehicle usage by each district.

Figure 3 normalizes the data by dividing the number of crashes in each district by the number of total vehicles within that district. This still may not give a complete picture since the number of hours or miles each vehicle is driven may vary widely between districts.

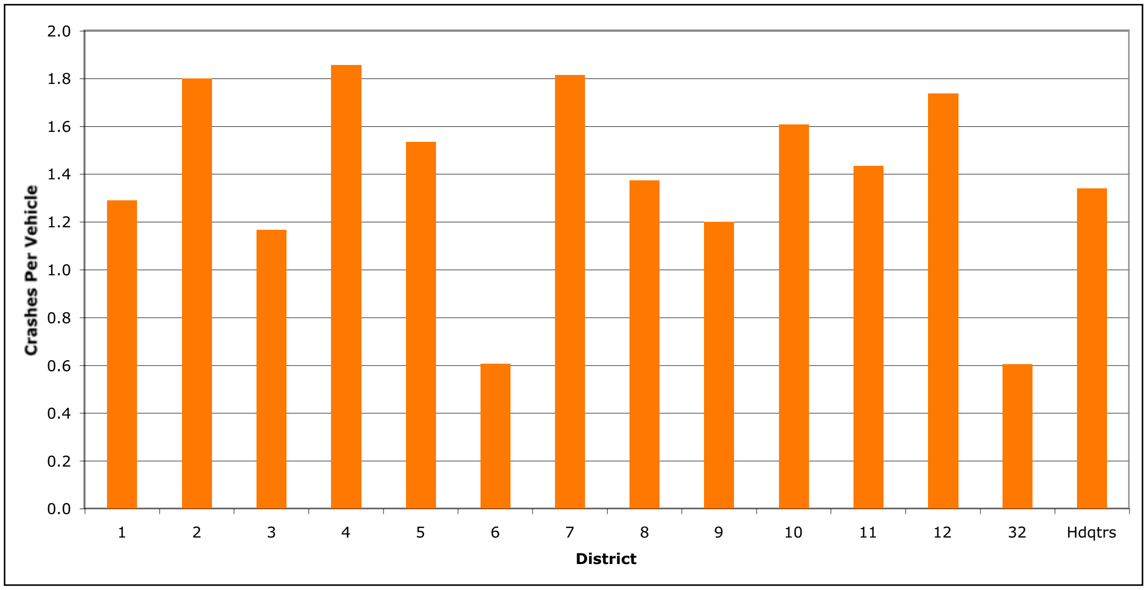
Data in Figure 4 reveals the rather surprising fact that a number of drivers involved in crashes were not wearing seatbelts, since this is a violation of Caltrans' policy as well as state law.

One of the items recorded in accident reports is preventability. The crash investigator has the option of deeming the crash non-preventable or assigning responsibility to the driver, another involved party, or another Caltran's employee. The results are shown in Figure 5. With over 50% of crashes deemed preventable by Caltrans drivers, remedial action, whether through policy, procedure, or equipment changes could prove of great benefit.

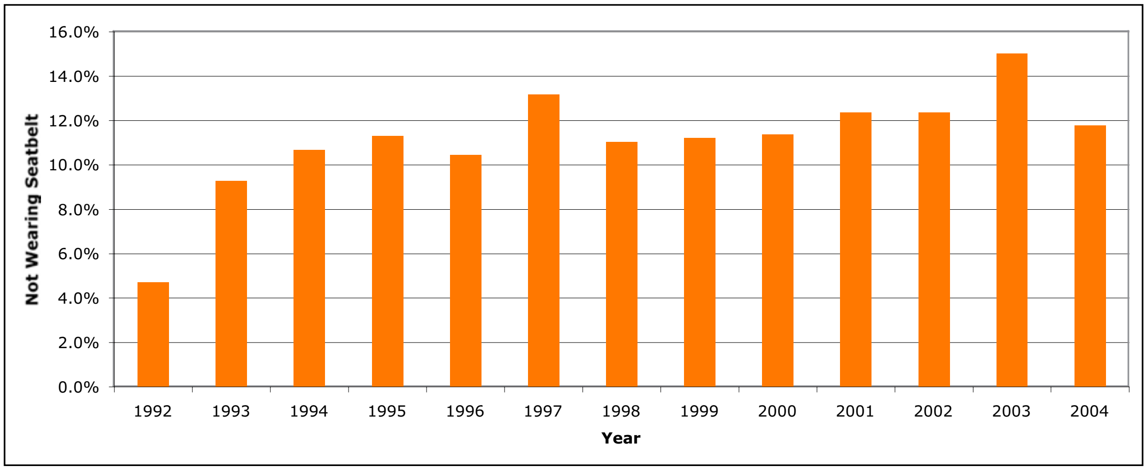
## FIGURE 2: CRASH FREQUENCY BY DISTRICT



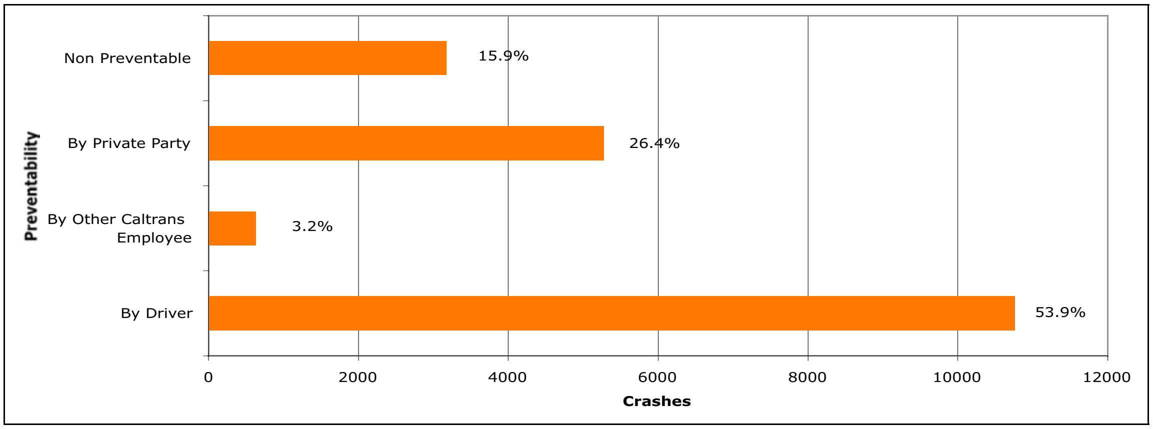

## FIGURE 3: CRASH FREQUENCY PER VEHICLE BY DISTRICT



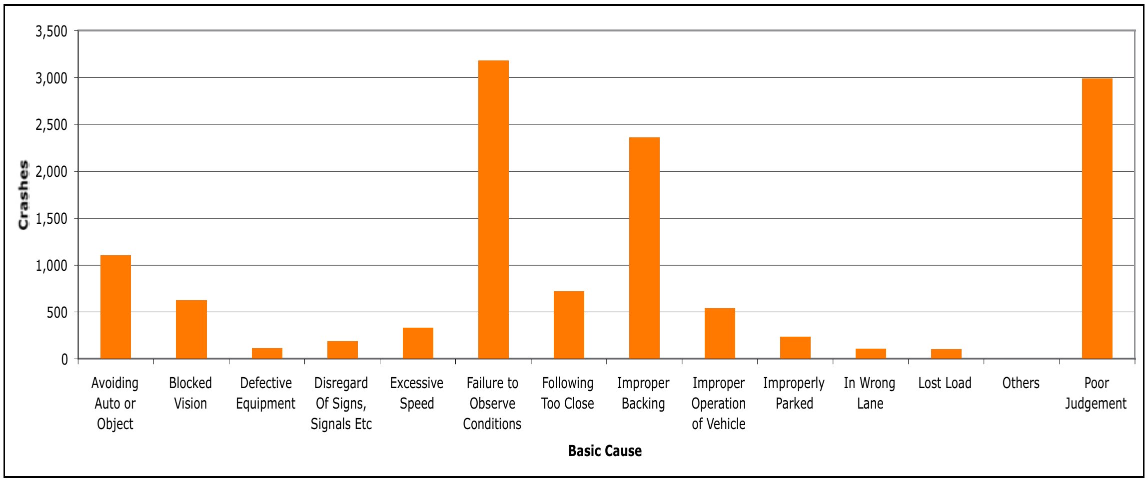

## FIGURE 4: PERCENTAGE OF CRASH-INVOLVED DRIVERS NOT WEARING SEATBELT



## FIGURE 5: CRASH FREQUENCY BY PREVENTABILITY




## FIGURE 6: CRASH FREQUENCY BY BASIC CAUSE

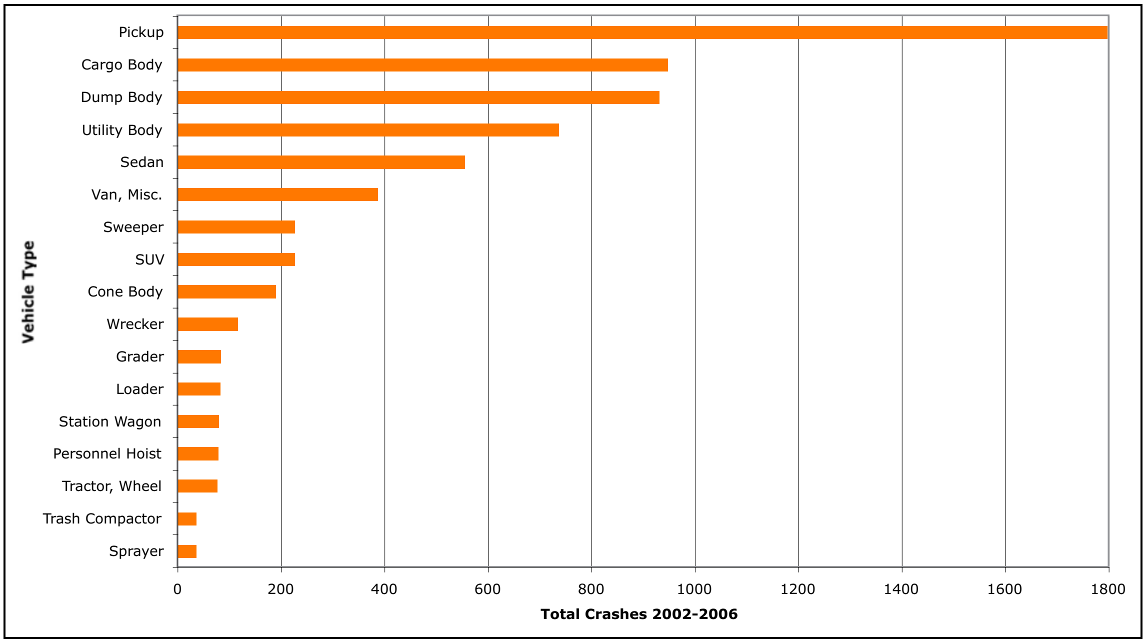



The next category of interest is the basic cause assigned to the crash. The results are shown in Figure 6. Unfortunately, lack of detail makes such categories as "Improper Backing" and "Failure to Observe Conditions" difficult to interpret.

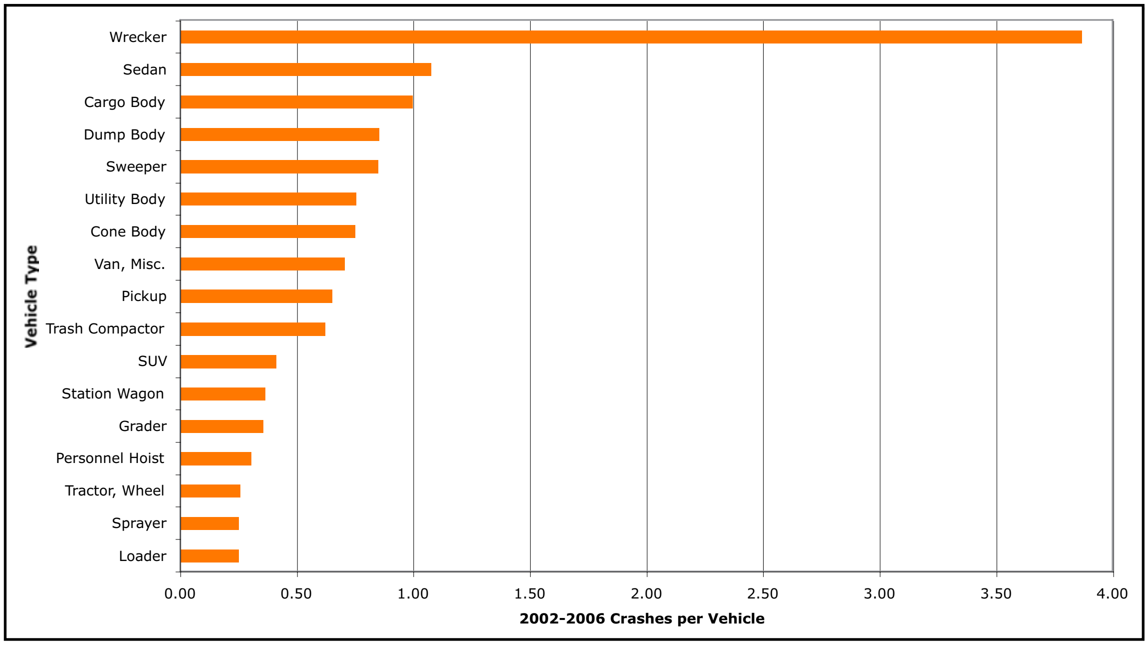
Moving toward a more specific view of the data, Figure 7 breaks down five years of crash data, 2002-2006, by the type of vehicle involved. Even though the data is not normalized by the number of vehicles of each type in the Caltrans' inventory, it does give focus for potential remedial action.

Figure 8 offers more information as it shows the number of crashes per vehicle. However, the usefulness of the data is limited by the absence of specifics such as the severity of the crashes or the magnitude of the problem. For this reason, the information here must be viewed in conjunction with Figure 7 for a more complete picture.

## FIGURE 7: TOTAL CRASHES BY VEHICLE TYPE

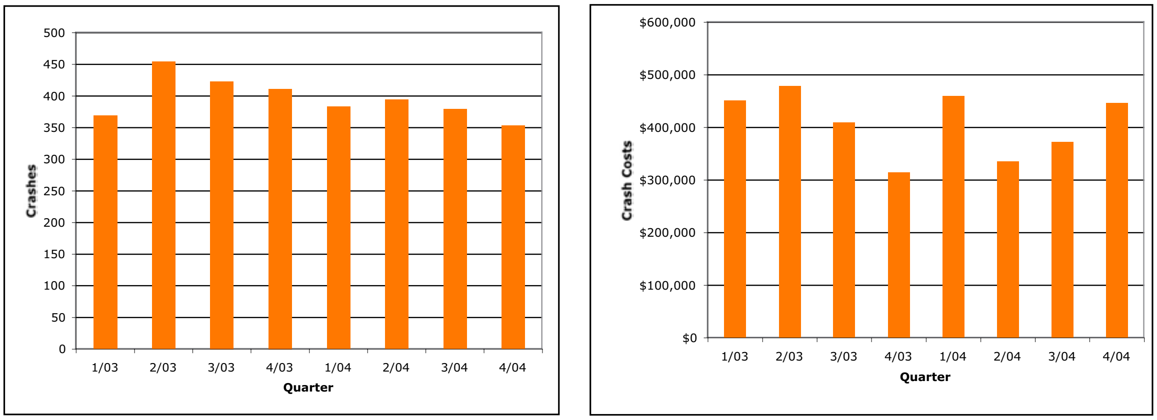



## FIGURE 8: CRASHES PER VEHICLE BY VEHICLE TYPE




Quarterly data can be very useful for giving early indications of emerging trends, Figure 9 shows quarterly totals in crashes and crash-related costs for a two year period. Care must be taken not to confuse seasonal variation with changes in trends.

## FIGURE 9: QUARTERLY TOTAL CRASHES AND CRASH COSTS

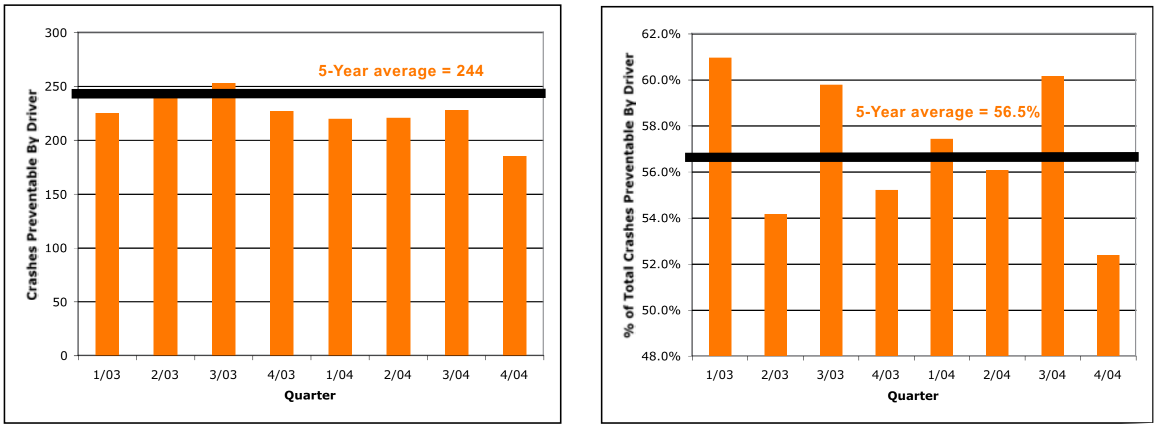



TOTAL NUMBER OF CRASHES

TOTAL COST OF CRASHES

Quarterly data can also be useful when compared to a moving average. In Figure 10, quarterly crashes preventable by the driver, viewed as both total numbers and as a percentage of all crashes, are compared to their five-year averages.

## FIGURE 10: QUARTERLY CRASHES PREVENTABLE BY DRIVER

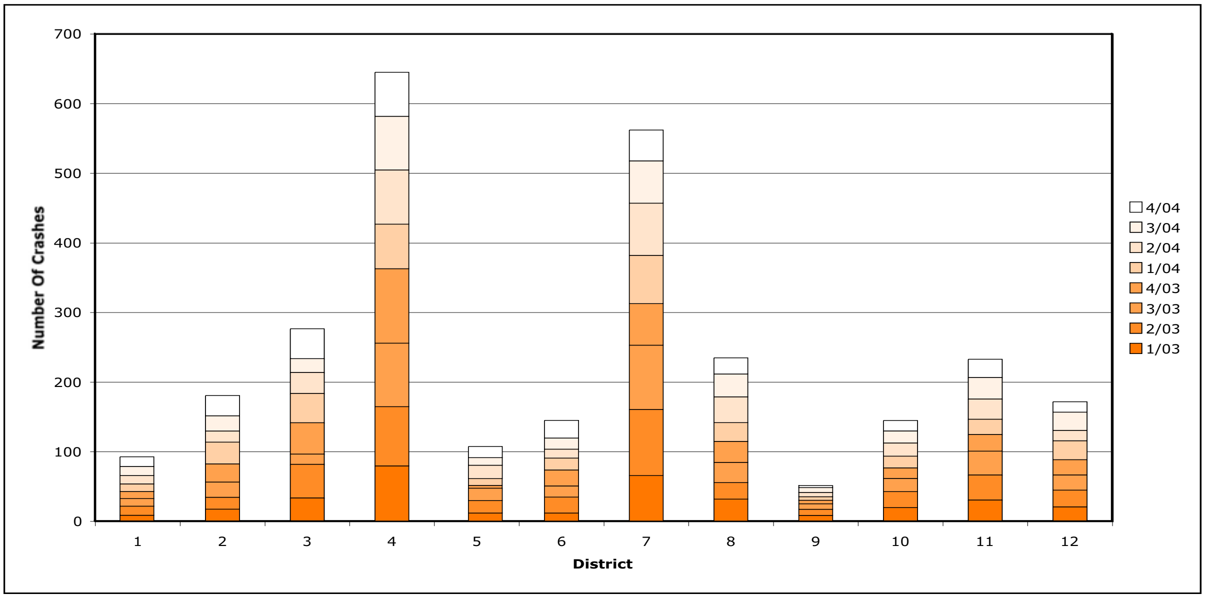



NUMBER OF PREVENTABLE CRASHES

PERCENTAGE OF ALL PREVENTABEL CRASHES

The final figure shows quarterly crashes by district. Since it is not normalized it should only be used to compare quarters within a district and not between districts. Seasonal variation should also be taken into account.

## FIGURE 11: QUARTERLY CRASHES BY DISTRICT



CALIFORNIA PATH

Traffic Safety Center
Setting New Directions in Traffic Safety