Analyzing Incident and Accident Data to Improve Worker Safety

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Background

The Caltrans mission, vision, goals and values place a high priority on safety. Caltrans is seeking data that will inform the development of best practices in implementing improved highway worker safety features such as maintenance vehicle pullouts, access gates, and clustering and relocating of facilities away from traffic. Identifying the relationship between worker injuries and fatalities with the location of the worker, the specific work tasks being conducted at the time of the incident, and the environmental factors contributing to the incident will help Caltrans develop these best practices.

Data available from Caltrans incident and accident reports can provide much of the information needed to analyze maintenance worker risk, including:

- Work tasks associated with the following Caltrans maintenance crew types:
  - Bridge repair.
  - Electrical.
  - Fence and guardrail/special crews.
  - Graffiti.
  - Landscape.
  - Pavement marking.
  - Roadway.
  - Sign.
  - Stencil.
  - Stormwater.
  - Striping.
  - Sweeping operation.
  - Tree.

- Location and environmental factors contributing to the incident, including county, route and post mile, road condition, weather, time, and location of the worker at the time of the incident (proximity to shoulder or roadway, gore location, etc.).
- Type of injury the employee sustained during the incident.

CTC & Associates consulted with Caltrans staff and examined a small sample of Caltrans Close Call Incident Reports filed by Caltrans districts between 2009 and 2015. Using this information, CTC prepared a draft spreadsheet that can be used as a template to organize and analyze data associated with Caltrans' close call incidents and injury and fatality accidents.

Spreadsheet Template for Data Analysis

With Caltrans' guidance, CTC used incident data to prepare a draft spreadsheet to track close call incidents and injury and fatality accidents. The data used to populate the draft spreadsheet was taken from:

- Eleven of the 67 Close Call Incident Reports provided by Caltrans.
- A comprehensive summary of incident reports filed between 2009 and 2015. This summary spreadsheet provides limited information about 179 incident reports filed during this period, including district, date, route and a brief incident description.

Selection of the data fields to appear on the draft spreadsheet was guided by the data available on the incident reports and additional data requested by Caltrans. Though additional data fields for annual average daily traffic (AADT), highway type, highway environment and land use were initially requested for the data analysis, Caltrans decided to delay adding these fields to the spreadsheet (none of this data is available from incident reports). Injury type, another data field initially requested by Caltrans, does not appear in the draft spreadsheet given the absence of injury and fatality reports in the information provided by Caltrans.

The draft Summary of Close Call Incident Reports spreadsheet is included as Appendix A to this Preliminary Investigation; Appendix B provides field codes and descriptions for use in reviewing the draft spreadsheet. The draft spreadsheet's data fields and the source for data in each field are presented in the table below.

Draft Spreadsheet Data Fields and Sources

Data Field	Data Source
Incident Date	Incident report
District	CTC entry (taken from Caltrans' organization of incident reports)
County	Incident report
Season	CTC entry (determined from incident date)
Incident Time (24-hour clock)	Incident report
Time of Day	CTC entry (determined from incident time)
Route	Incident report

Draft Spreadsheet Data Fields and Sources	
Data Field	**Data Source**
Post Mile	Incident report
Direction	Incident report
Incident Severity	Type of report (close call, injury or fatality)
Incident Location	Incident report
Non-Lane Closure Work Area	Incident report
Moving Operation/Adjacent To	Incident report
Reversible Lane Closure (Flagging)	Incident report
Number Lanes Open	Incident report
Number Lanes Closed	Incident report
Work Category	Incident report
Work Task	CTC entry (determined from incident report's description of activity)
Incident Type*	Incident report
Supplemental Incident Type	Incident report
Contributing Factor**	Incident report
Contributing Factor	Incident report
Contributing Factor (Other)	Incident report
Details (Incident Description)	CTC entry (taken from comprehensive summary of incident reports filed between 2009 and 2015)
Change in Procedure (Y/N)	Incident report
Change in Procedure (Description)	Incident report
Recommendation	CTC entry (summarized from incident report's recommendation)

* The Incident Type data field includes a supplementary column to reflect additional entries made by form users who ignored the instruction to "check one." While the additional column permits sorting of individual entries, entries could be combined into a single column if desired.

** The draft spreadsheet includes three columns for the Contributing Factors data field to allow for sorting of individual responses. Two of the columns are for recording standard responses (such as Poor Visibility or Wet/Icy Pavement); the third column is for recording "Other" factors.

Potential Template Enhancements

The draft spreadsheet includes data for only 11 of the 179 incident reports Caltrans districts filed between 2009 and 2015, and includes no data from injury or fatality reports. Additional data fields may be required to accommodate the information contained in injury and fatality reports if

that data is added to the draft spreadsheet. Environmental factors initially of interest to Caltrans do not appear in the draft spreadsheet but could be added if desired.

Existing Databases

An alternative to development of the spreadsheet template described above is the use of accident and injury data available through existing databases. Three of these databases are described below. Of these, the Work Zone Accident Injury Database will likely be of greatest interest to the Caltrans project team.

- **Work Zone Accident Injury Database**. Developed by researchers at the University of California, Davis, this database, available at http://wzsafety.ahmct.ucdavis.edu/main/, contains information from Traffic Collision Reports prepared by California Highway Patrol for locations considered to be work zones at the time of the collision. Users can register and log in to a web site that provides access to the database's information and tools.

  Related Resource:

  Work Zone Injury Data Collection and Analysis, Bahram Ravani, Patricia Fyhrie, Kristopher Wehage, Arash Gobal and Hiu Y. Hong, Caltrans, August 2015. http://www.dot.ca.gov/newtech/researchreports/reports/2015/CA16-2257_FinalReport.pdf
  This report addresses the development and intended use of the Work Zone Accident Injury Database.

- **Traffic Accident Surveillance and Analysis System (TASAS)**. This database captures incident details for collisions on California state highways, including the post mile location of each incident. Caltrans is currently conducting a research project (see Related Resource below) aimed at enhancing how TASAS is populated with collision data and how these data are linked to a linear referencing system.

  Related Resource:

  "TASAS (Traffic Accident Surveillance and Analysis System) and Injury Data Base Development," *Research Notes*, Caltrans, October 2015. http://www.dot.ca.gov/newtech/researchreports/current_research/TransportationSafety&Mobility/docs/Task2906_RNs_11-2015.pdf
  This project will streamline and digitize the process of coding and data extraction from Traffic Collision Reports for populating the TASAS database, and is also expected to have an impact on the Work Zone Accident Injury Database. The goals of this project in progress, expected to conclude in September 2017, include (from page 2):

  > The main goal of the research is to develop methods that would facilitate data extraction and processing for both the coding portion as well as for populating the TASAS database. This ongoing effort is also intended to be consistent and take advantage of the new efforts by the CHP to have all TCRs [Traffic Collision Reports] in electronic format.

The secondary objective of the study is to use some of the newly processed police TCRs to add to the existing California work zone injury database for potential evaluation of mitigation methods.

- **Safety Information Management System (SIMS)**. This Caltrans database contains safety data that is used for statistical analysis at Caltrans. The database contains information culled from forms that are completed each time a Caltrans vehicle is involved in an accident. These forms include:
    - *Accident Identification Card*. Completed by the driver at the scene and turned over to the driver's first-line supervisor.
    - *Vehicle Accident Report*. Completed by the driver upon returning to the office and turned over to the driver's first-line supervisor.
    - *Data Input for Motor Vehicle Accident*. Completed by the first-line supervisor based on information provided by the driver and the results of an investigation. This form includes data used to determine whether the driver could have prevented the crash.

Related Resources:

Develop Methods to Reduce or Prevent Backing Crashes, Douglas L. Cooper, Sarah Duffy, Phyllis Orrick and David R. Ragland, Caltrans, May 2010.
http://www.dot.ca.gov/newtech/researchreports/reports/2010/final_report_task_0940.pdf
While not specific to work zone crash data, this report provides a description of the data included in SIMS (see page 2 of the report; page 20 of the PDF). Suggestions for improving information management within SIMS begin on page 12 of the report (page 30 of the PDF).

Development of a Safety Management Protocol, Douglas L. Cooper, Sarah Duffy, Laura Spautz, Glenn Shor and David R. Ragland, Caltrans, September 2008.
http://www.dot.ca.gov/newtech/researchreports/reports/2008/ca08-0581.pdf
This report, which sought to "address workplace injuries and accidents among Caltrans employees and develop recommendations to reduce their incidence among staff in the field," includes a discussion of SIMS and this goal (from the executive summary):

> Central to shaping the planning and implementation of Caltrans' safety management program is the SIMS system, Caltrans' database of accidents and injuries that the agency uses to track and analyze accident information within the organization. One of Caltrans' goals is to expand SIMS' scope beyond mitigating injuries and use it to provide more comprehensive and accessible information in order to standardize and coordinate safety management systems among the 12 districts.

Next Steps

Moving forward, Caltrans could consider:

- Using the data available from an existing database, especially the Work Zone Accident Injury Database, and perhaps supplementing that data with additional data fields of interest to Caltrans.

- Expanding on the template developed for this project, including:
    - Adding data to the draft spreadsheet from the remaining incident reports for the period 2009 through 2015.
    - Gathering injury and fatality accident reports and entering data from them into the draft spreadsheet, adding new data fields as needed.
    - Adding new data fields to the draft spreadsheet to reflect the environmental factors associated with the incidents and accidents reported. These factors may include AADT, highway type, highway environment and land use.

Appendix A Summary of Close Call Incident Reports

	Incident Date	District	County	Season	Incident Time (24-hour clock)	Time of Day	Route	Post Mile	Direction	Incident Severity	Incident Location	Non-Lane Closure Work Area	Moving Operation / Adjacent To
1	1/14/2015	2	Shasta	Winter	2100	Evening	44	0.93	WB	Close call	WK AREA	N/A	N/A
2	12/12/2014	1	Mendocino	Fall	1000	Morning	101	48.14	SB	Close call	N/A	SHLDR	N/A
3	10/23/2015	1	Mendocino	Fall	0830	Morning	1	64.50	NB	Close call	WK SIGN LOC	N/A	N/A
4	7/21/2015	2	Lassen	Summer	1930	Evening	395	14.60	NB	Close call	WK AREA	N/A	N/A
5	7/29/2015	2	Lassen	Summer	0950	Morning	70	2.90	WB	Close call	WK SIGN LOC	N/A	N/A
6	11/13/2014	1	Humboldt	Fall	1030	Morning	101	67.00	SB	Close call	LN CLOS	N/A	MOV OP SHAD VEH
7	2/5/2015	1	Humboldt	Winter	1530	Afternoon	169	22.66	WB	Close call	N/A	N/A	MOV OP WK VEH
8	10/20/2015	2	Siskiyou	Fall	1240	Afternoon	5	24.00	NB	Close call	WK AREA	N/A	N/A
9	7/8/2014	2	Shasta	Summer	1035	Morning	5	17.00	SB	Close call	N/A	SHLDR	MOV OP WK VEH
10	4/1/2014	2	Siskiyou	Spring	1333	Afternoon	5	58.18	NB	Close call	WK AREA	N/A	N/A
11	10/22/2015	2	Plumas	Fall	0900	Morning	70	51.52	WB	Close call	N/A	N/A	N/A

Appendix A Summary of Close Call Incident Reports

	Incident Date	District	Reversible Lane Closure (Flagging)	Number Lanes Open	Number Lanes Closed	Work Category	Work Task	Incident Type	Supplemental Incident Type	Contributing Factor
1	1/14/2015	2	N/A	1	1	BRIDGE	Lane and ramp closure to repair high load hit.	VEH ENTER CONED AREA	NEAR COLL VEH WK ZONE	N/A
2	12/12/2014	1	N/A	N/A	N/A	TREE	Trimming limbs from tree fallen near travelway.	VEH OUT CNTRL	N/A	N/A
3	10/23/2015	1	FLAGGING / FLAG AREA	1	1	RDWY	Paving/grinder digouts.	VEH STR OBJ WK ZONE	N/A	N/A
4	7/21/2015	2	FLAGGING / FLAG AREA	1	1	RDWY	Cleaning up mudslide.	VEH ENTER CONED AREA	N/A	N/A
5	7/29/2015	2	FLAGGING / FLAG AREA	N/A	N/A	RDWY	Grinding operation.	NEAR COLL VEH WK ZONE	N/A	N/A
6	11/13/2014	1	N/A	2	1	SWEEP	Sweeping operation along median wall.	VEH OUT CNTRL	N/A	N/A
7	2/5/2015	1	N/A	1	N/A	RDWY	Caught in active slide when responding to slide report.	N/A	N/A	N/A
8	10/20/2015	2	N/A	1	1	STRIPE	Striping at approx 20 mph.	VEH STR OBJ WK ZONE	N/A	CELL
9	7/8/2014	2	N/A	2	N/A	LANDSCAPE	Litter removal; picking up rubber on shoulder.	VEH OUT CNTRL	N/A	N/A
10	4/1/2014	2	N/A	1	1	BRIDGE	Repairing deck spalls.	VEH ENTER CONED AREA	N/A	N/A
11	10/22/2015	2	FLAGGING / FLAG AREA	1	1	BRIDGE	Flagging for bridge.	N/A	N/A	N/A

Appendix A Summary of Close Call Incident Reports

	Incident Date	District	Contributing Factor	Contributing Factor (Other)	Details (Incident Description)	Change in Procedure (Y/N)	Change in Procedure (Description)	Recommendation
1	1/14/2015	2	N/A	N/A	Errant vehicle entered ramp being closed, going around cones and barricades, narrowly missing employee on foot.	N	N/A	Always have an escape route.
2	12/12/2014	1	N/A	Out-of-control vehicle crossover in head-on collision.	Head-on collision near work zone sends motorist into area where he had just been standing.	N	N/A	Freak accident; unpreventable.
3	10/23/2015	1	N/A	Impaired private party.	Motorist fell asleep and woke up in time to avoid hitting vehicles stopped at flagger station and ended up hitting a tree and sustaining minor injuries.	N	N/A	Always stay alert.
4	7/21/2015	2	N/A	Inattentive driver.	Truck driver enters work zone in flagging operation, claims he did not see any signs.	N/A	N/A	Use of rumble strips may have gotten driver's attention.
5	7/29/2015	2	N/A	Inattentive driver.	Errant motorist clips last vehicle in queue and swerves into other lane.	N	N/A	None
6	11/13/2014	1	N/A	Inattentive driver.	Inattentive motorist crashed into center median wall ahead of sweeping operation.	N	N/A	Use more MAZEEP in this area.
7	2/5/2015	1	N/A	Heavy rain caused slide.	Crew caught in slide when responding to another slide. No injuries.	N	N/A	Advise safe, slow travel in adverse weather; radio communication between crew members crucial to safety; stay alert and cautious when responding to slides.
8	10/20/2015	2	NO ENG	Impaired private party (driving in a hypnotic state).	Errant motorist rear-ends shadow vehicle being used in a striping operation.	Y	Use of two MAZEEP officers	Future use of MAZEEP officer between changeable message sign truck and attenuator; another truck on shoulder with an arrow may also be helpful.
9	7/8/2014	2	N/A	Unsafe lane change.	Vehicle side-swiped barrier vehicle during litter removal operation.	N	N/A	None
10	4/1/2014	2	N/A	N/A	Motorhome knocked off mirror of truck parked in closure.	N	N/A	None
11	10/22/2015	2	N/A	Inattentive driver.	Errant motorist runs flagger station during bridge work.	N	N/A	Use MAZEEP when available; set out rumble strips in work area where shoulders are wide enough; stay alert; and know escape routes.
							Defined Term:	MAZEEP = Maintenance Zone Enhanced Enforcement Program

APPENDIX B

Summary of Close Call Incident Reports: Field Codes and Descriptions

Data Field	Code / Description
Season	Winter = Jan, Feb, Mar
	Spring = Apr, May, Jun
	Summer = Jul, Aug, Sep
	Fall = Oct, Nov, Dec
Time of Day	Morning = 6:01 a.m. to noon (0601 to 1200)
	Afternoon = 12:01 to 6 p.m. (1201 to 1800)
	Evening = 6:01 p.m. to midnight (1801 to 2400)
	Overnight = 12:01 to 6 a.m. (0001 to 0600)
Incident Severity	Close call
	Injury
	Fatality
Incident Location	LN CLOS = In or adjacent to lane closure
	WK AREA = Work area
	BETW TAPER & WK AREA = Between taper and work area
	CLOS TAPER = Closure taper
	WK SIGN LOC = Work sign locations
Non-Lane Closure Work Area	MED = Median
	SHLDR = Shoulder
	RDSDE/LNDSCP AREA = Roadside/landscape area
Moving Operation/Adjacent To	MOV OP WK VEH = Moving operation adjacent to work vehicle
	MOV OP SHAD VEH = Moving operation adjacent to shadow vehicle
	MOV OP ADV WRN VEH = Moving operation adjacent to advance warning vehicle
Reversible Lane Closure (Flagging)	FLAGGING / WK AREA = Reversible lane closure (flagging) work area
	FLAGGING / FLAG AREA = Reversible lane closure (flagging) flagger's area
Work Category	BRIDGE = Bridge repair
	ELEC = Electrical
	FENCE / SPEC = Fence and guardrail/special crews
	GRAF = Graffiti

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Summary of Close Call Incident Reports: Field Codes and Descriptions

Data Field	Code / Description
Work Category	LANDSCAPE = Landscape
	PVMT MRK = Pavement marking
	RDWY = Roadway
	SIGN = Sign
	STENCIL = Stencil
	STRIPE = Striping
	STRM = Stormwater
	SWEEP = Sweeping operation
	TREE = Tree
Incident Type	VEH ENTER CONED AREA = Vehicle entered coned-off area
	VEH OUT CNTRL = Vehicle out of control
	WWD = Wrong-way driver
	CONE KNCK OVER = More than one consecutive cone knocked over
	EXCESS SPD = Vehicle using excessive speed in work zone area
	NEAR COLL VEH WK ZONE= Vehicles nearly collide in work zone area
	OBJCT = Object thrown at employee
	VEH STR OBJ WK ZONE = Vehicle collides/strikes object in work zone area
Contributing Factor	CELL = Private-party driver using cell phone
	POOR VIS = Poor visibility due to weather
	SIGNS DWN = Traffic/work signs down
	WET/ICY PVMT = Wet/icy pavement
	INCORR CMS = Incorrect message on changeable message sign
	NO ENG = Private party does not understand English
	OTH = Other