San Francisco Police Department

Traffic Enforcement Citations and

Collission Investigation Processes

“As-Is”

DRAFT April 18, 2014 Version 1.

Traffiic Patterns and Colissions, Pedestrian Fatalities, City of San Franciasco, California

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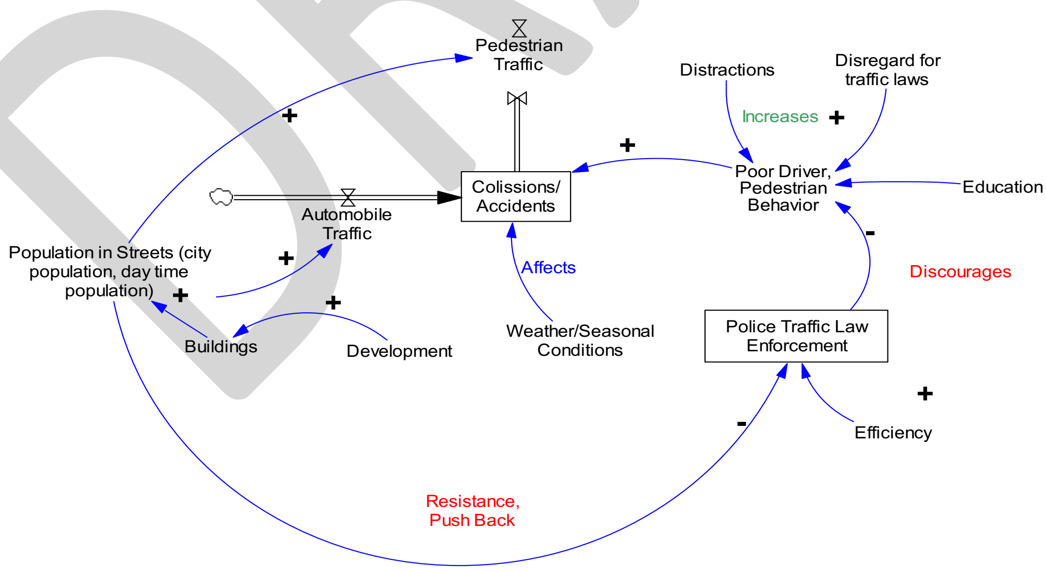

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PART I 'AS IS' TRAFFIC CITATION PROCESSES

1.0 EXECUTIVE SUMMARY

The current SFPD Traffic Enforcement and Collision Investitation Process, traffic management, are depicted here in three primary process areas: 1) citation life cycle, 2) accident investigation and reporting, and 3) court ajudication.There are multiple interfaces between these overall system components and within a process area. Additionally there are external interfaces. Part II of this report proveds some initial 'As-Is' statistics and some ideas for future work.

Initial analysis shows less than optimal capture, storage, retrival ability, and anlysis of traffic citation data, which can be useful in selective and high visability traffic law enforcement. About 75% of traffic tickets issued are paper based and are not completely captured directly into a SFPD database. Though, a work around is used in which certain data points on citations are manually captured from the paper citations at the district stations that does provide some relatively immediate citation information on the five critical violation types

About 25% of traffic citations are currently issued via a pilot test "CrossRoad" commercial 'eCitation' product. A pdf image reproduction of a comparable paper ticket is prited out and forwarded to the court, which also receives the paper based citations. Thus, the pilot CrossRoads eCitations (paper images) flow into the existing court process that works with paper citations.

Initial traffic collision investigative reports, and data points are captured by paper and pen at a scene and then later entered into the California Highway Patrol CARS data entry Microsoft Word Form. A paper print out of this Word collission investigation report is mailed to the California Highway Patrol for its state wide data collection, and is also scanned and sent to the CrossRoads pilot test sytem. The CrossRoads system then uses this data commercially and forward it to the California SWITRS system. Five years of past accident information has been posted to the local SFPD CrossRoads database.

There is no live caputre of traffic accident data into a SFPD database, which, if done, would allow improved data analysis and correlation between enfocement efforts and results, and accident data.

This analysis provides a starting point for further efforts to improve the SFPD overall traffic enforcement and collission investigation capability.

2.0 INTRODUCTION

The mehodology used for this analysis was personal interview with key knowledgable police department personnel, and direct examination of existing processes, tools, documents and artifacts, and some research into data from national traffic agencies, and the California Highway Patrol offices.

3.0 REFERENCE MODELS

The reference model, Figure 1, included is an abstract definition and depection of concepts, and idealized processes, steps, functions, internal and external interface, and artifacts identified in the life cycle of traffic law enforcement and collission investigation performed by the San Francisco Police Department. Consistent with the genereal use of reference models, no particualar implementation, realization, or solution is referenced in this model, and the actual realization and implementiton of the SFPD "as-is" system and processes may or may not map exactly to the refernce model.

Best practices and systems engineering huestrics identify system interfaces, internal component to componet and external, provide the greatest leverage and risk areas. Also, mangement and design of feedback loops, both positive and negative, are critical to overall system performance.

An optimal feedback loop is from the citation issuance data: location, time, violation, etc to the selective and high visiblity enforcement effort

4.0 PRESENT "AS-IS" SYTEM(S) AND PROCESSES

San Francisco traffic law enforcement and collision investigation is managed by "K" Company, an independent command within the Field Operations Bureau, the Traffic Company, or Company K as it is sometimes referred to, is responsible for traffic enforcement throughout the City. Company K is charged with three main missions:

- Investigation of injury traffic accidents
- Enforcement of laws and ordinances (moving violations) designed to reduce accidents
- Handling traffic-related issues at special events, including dignitary escorts, major parades, demonstrations, large athletics events and selected

The Traffic Company is comprised of the following components:

- Enforcement and Investigation
- Traffic Administration
- Serious Traffic Offender Program (STOP)

- Training and Maintenance Unit

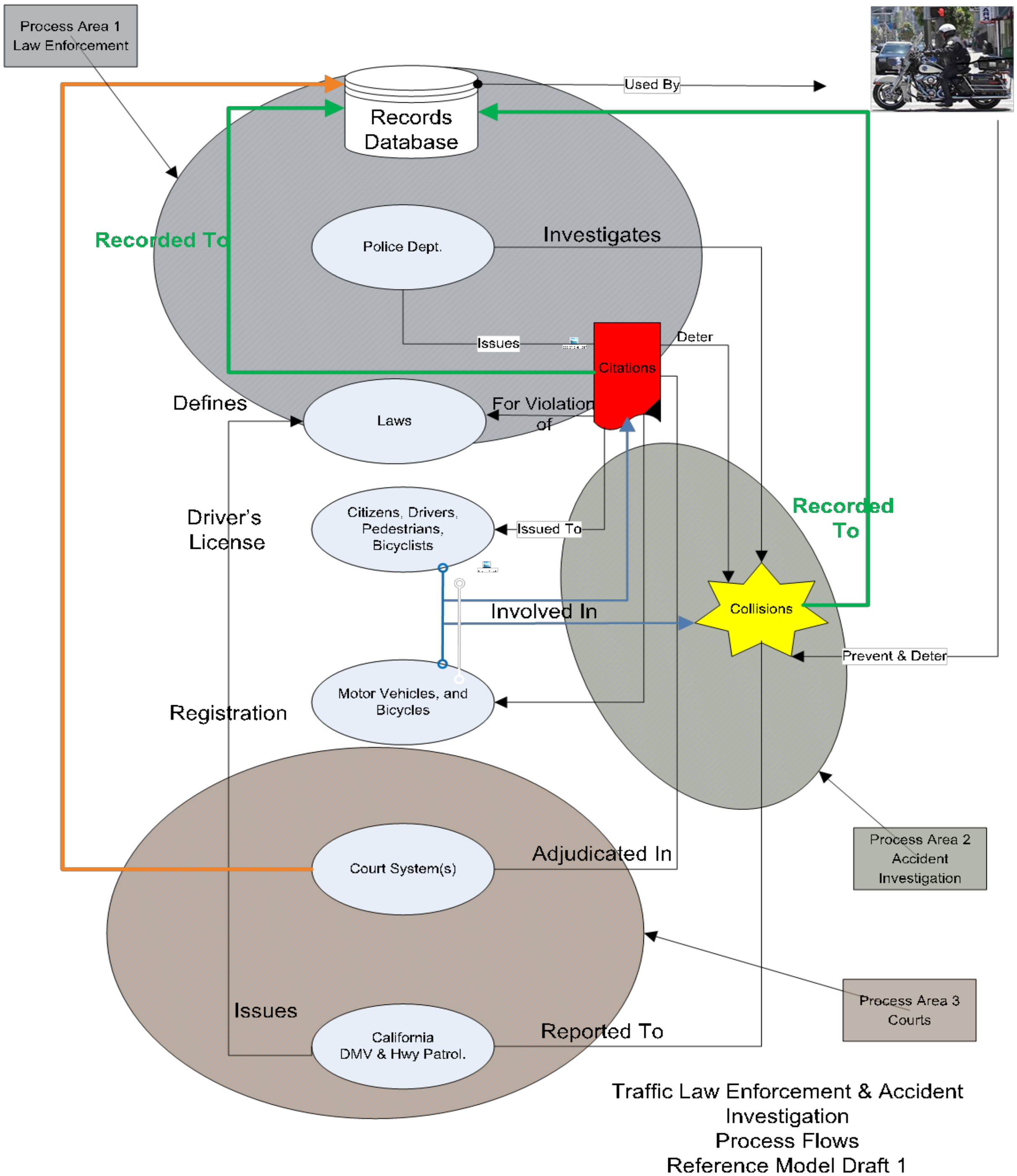
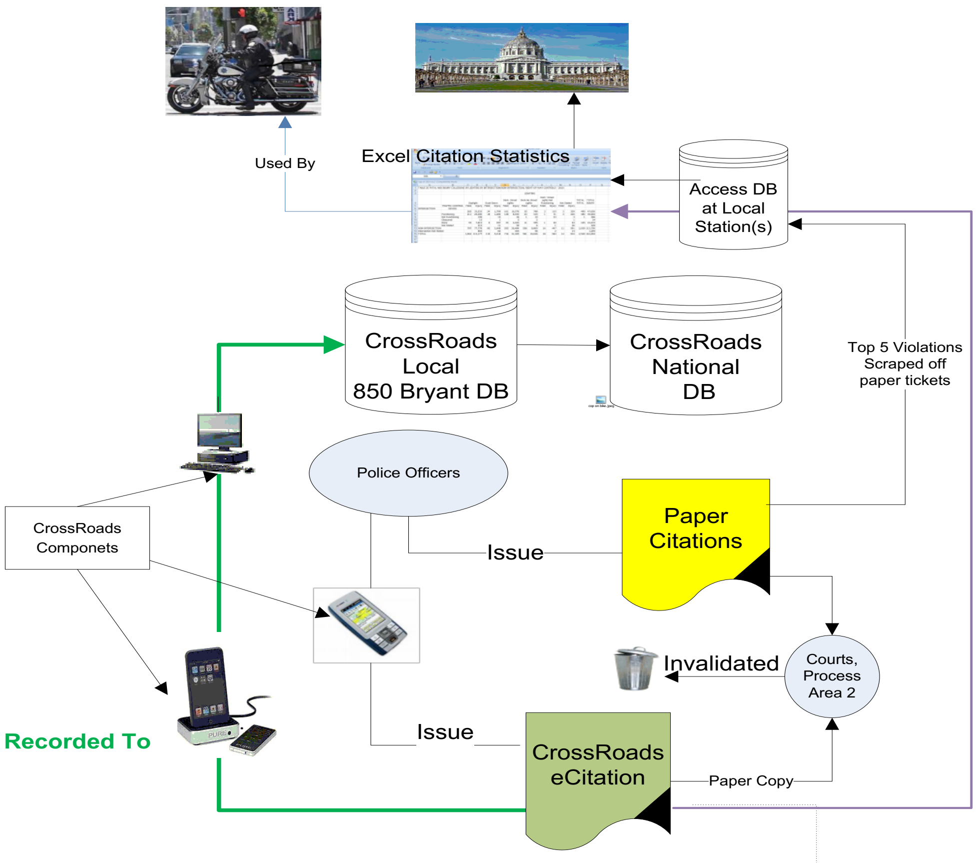


Figure 1. Overall Reference Model

The overall reference model depicts 'a' high level logical and process model of the three process areas, Citations, Accidents, and Courts. These are highlighted by the different colored ellipses. This is a reference model, and not necessarily the same as implemented at SFPD.

Process Area 1, Citation Process

Figure 2, below, prsents a drill down focused on process area 1 of the reference model, the traffic citation process.



Traffic Law Enforcement & Accident
Investigation
Process 1, Traffic Citation, Drill Down

Figure 2, above, is a closer view of process area 1, traffic citation life cycle. Citation Process.

Process Area 1

Police officers issue traffic citations to citizens driving automobiles, walking as pedestrians, or riding bicyles. Citations issued are for violations of specifc traffic regulatory and regulations of the State of California and city and county of San

Francisco. Violations cited typically include violations speed limits, stop signs, red lights, failure to yield, expired automobile registration, or invalid California state issued driver's licenses.

In the reference model, this is process area 1 where the general high level process and information flow is:

- Violation observed and citation issued by police officer
- Detailed information on the circumstance of the violaation, the drive, vehcile, date, time, location, and specific violation law reference (citation data), and a court appearance date and time (or forfieture process) are recorded
- A citation copy is
  - given to the cited person and a
  - copy is preserved by the police offier
  - a copy of citation data is forward to 4th floor of the HOJ for identity and records management and a copy then sent on to the court
  - In the refernce model (not as-is) digital data of the citation would be captured into the a raffic records data base, such as the CDW

Citation data (process area 1) and accident investigation data (process area 2) recorded in a relational traffic records data are useful for police selective enforcement/high visibility enforcement targeted to high accident areas and times, and engnieering and design of streets and directed traffic flows,

4.1.1 Paper Citations A majority, estimated at 70% of the 87,00 citations issed in 2013, or 61,000, for misdomenor law violations, which can include traffic law and other violations, are paper and pen based, the "traffic ticket" or "citation.

During or at the end of an officer's shift, she or he turns in the paper citation at their district station. After review by the office in charge, a set of data points (the "focus on five") are manually captured from the paper citation:

- Red light violation
- Speeding
- Failure to yield to pedestrian in crosswalk
- Failure to yield while making left or U-Turn
- Failure to stop at a STOP sign limit line

These are entered into a Microsoft Acees database at the distict stations, and later used for anlysis by the Traffic Division Commander.

Though the referecne model calls for this citation data to be processed into the traffic records database, this is not an active process in the current 'as-is' process.

4.1.2 Electronic Citations: SFPD is pilot testing approximately 70 "CrossRoads" electronic citation units, and example of an electronic citation process system, "eCitation", of which approximately 50 are in service in K company, a proof of concept pilot implementation. All motocycle officers have CrossRoads systems and some are in black and white patrol cars.

The CrossRoad package consists of:

- a Motorola hand held device running a Micosoft Windows operating system, and an wireless aircard. The device resembles a rugedtized cell phone with a display screen and key pad. A Internet Web browser and and other Microsoft software are included.
-
- a small portable printer used to print out a paper citation record for the cited person.

- A docking station at a PC or Laptop computer running the CrossRoads program for loading and syncing the hand held device data to the CrossRoads local, SFPD, database.

- A desktop PC or Lapatop computer sytem for:

  - loading and syncing hand held device data
  - Querying and reporting from the CrossRoads Local SFPD database
- A CrossRoad server that hosts the CrossRoads database and communicates with a centralized 'main' database.

On creating a citation with the eCitation CrossRoads system, the officer enters citation information into the hand held device and has the cited person sign on the device's screen. The device will also scan and capture California driver's license from those California driver's licenses which the bar code or magnetic strip on them. This assures accurate information capture and recording.

Information captured into the hand held device is then transmitted to the small portable pritner, which prints out a paper copy of the citation for the cited person.

The CrossRoads software system has many drop down pick lists for quick and accurate selection of street location, traffic code violation, officer's ID, make, year and model of the car, for example.

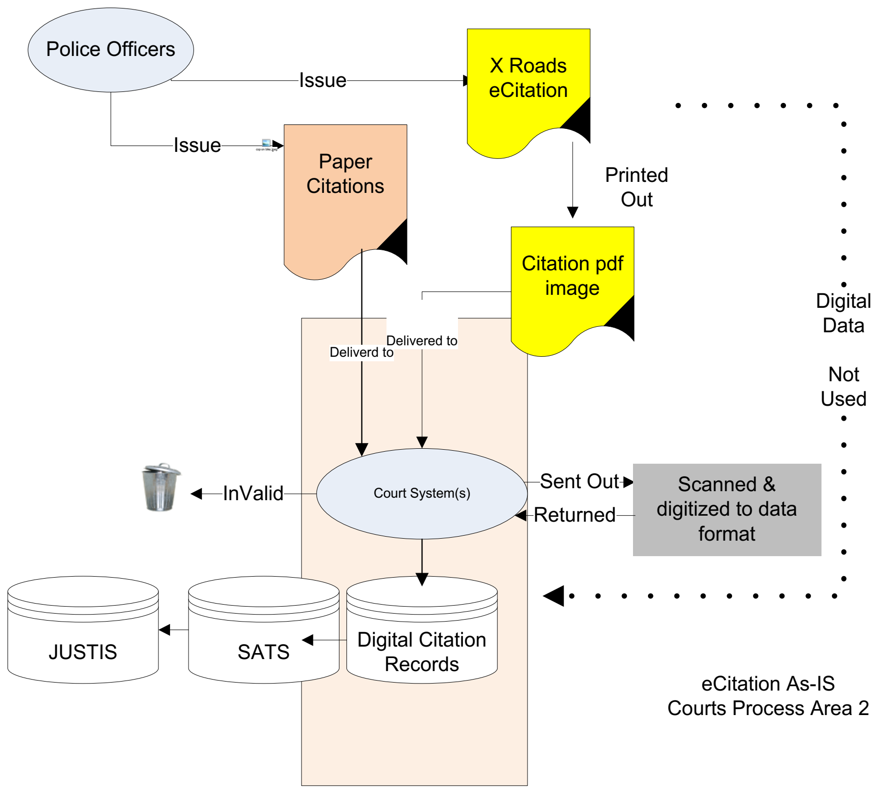


Figure 3, Court process area 2

4.1.3 Court Interfaces and Processes, Process Area 2

The California Superior Court proceses San Francisco Police Department issued traffic citations, other types of law violations, and violations from other agences

The court needs, uses, and retains paper based citations as the original citation/arrest document of record, *even with electronic digital capture of citation information.* Thus, the digital data from the pilot CrossRoads eCitation, or any future electronic citation process will always have to presented to the courts in a paper version of the citation. Presentation of electronic digital data format too might save the court their step of converting the underlying paper source document into digital format, which they do for processing of the citations.

Besides processing and tracking citations electronically, after conversion from the paper format, the courts upload San Francisco, and other jurisdiction's, citation information, and other law enforcment data into the JUSTIS database, which is shared by various law enforcment agencies.

Currently the periodic court-JUSTIS data upload includes the full court data set, not just incremental updates from the last upload.

A memorandum of agreement (MOU) is needed to capture data in the JUSTIS system. SFPD has one sample traffic citation data set from JUSTIS and a MOU is in process to allow SFPD access to traffic citation data.

In the future, should SFPD automate to electronically capture all the traffic citations it issues, the reach back to JUSTIS traffic citation would not be needed, except that disposition or other after-citation-issue data would only be available in JUSTIS.

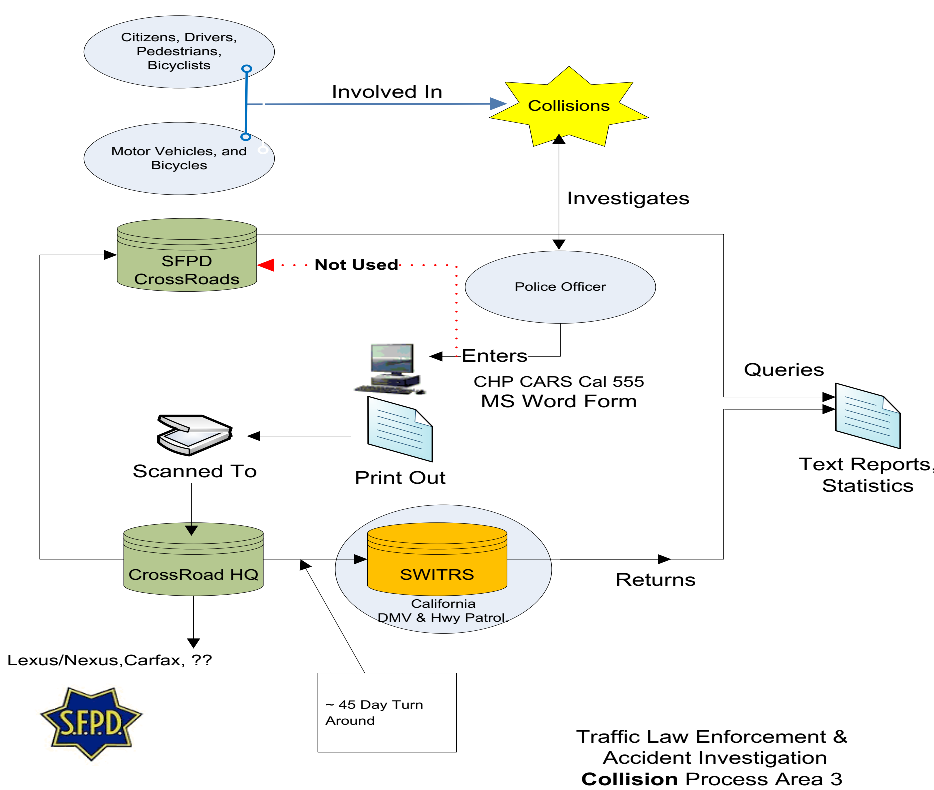


Figure 4, Collision Reporting Process area 3

4.1.4 Collision Reporting Processes/Systems, Process Area 3

SFPD traffic collision information is initially captured by investigation officers by pen and paper, or personal supplimental tools used by individual officers, such as voice recording (cell phone photos?) and entered into the CHP CARS desktop computer program. This tool is a Microsoft Word form modeled in the DMV California 555 (Cal 555) collision reporting form.

Copies of these Cal 555 collision reporting forms are then mailed to the CHP for their use, and eventual entry into the SWITRS, traffic collision reporting data base.

Electronic-digital capture of collission data is not captured in legacy SFPD systems, only paper print out copies of the Word document

4.1.5 CrossRoads Electronic Collision Reporting Although the CrossRoads pilot sytems in use does have a one the scene collision recording capability it is not being used or tested because the desktop software is out of date and compatibility with the hand held devices The CrossRoads designed process would provide for initial collission data information capture in the field, and then if needed, later more completed reporting in the CrossRoads desktop PC.

In the current CrossRoads pilot sytem, paper print outs of the Cal 55 collision report are scanned and sent to CrossRoads; CrossRoads then processes the collision data, capturing some for its own use, and then send digital information on the collision to the California SWITRS system. The turn around for the CrossRoads' process to make collision information available in digital format is about forty-five days. The print out of the Cal 55 form is also send via US Mail to the California Highway Patrol for their records and eventual posting in the SWITRS system (see below).

4.1.6 California Highway Patrol SWITRS System

SWITRS provides canned traffic collision reports on its website, and includes versions that can be filtered by jurisdiction, type of accident, date, etc. The reports are generated in serveral days and the requesting person is sent an email with a FTP Internet protocol link to retrieve the report. Current configuration of SFPD desktops block the FTP protocol for security reasons

Concept Mapping of Citation, Collision Investigation and Court

5.0 Other Systemic Views

Multiple views and depictions of a system can provide quick visual views of system elements or concepts.

5.1 Concept Map

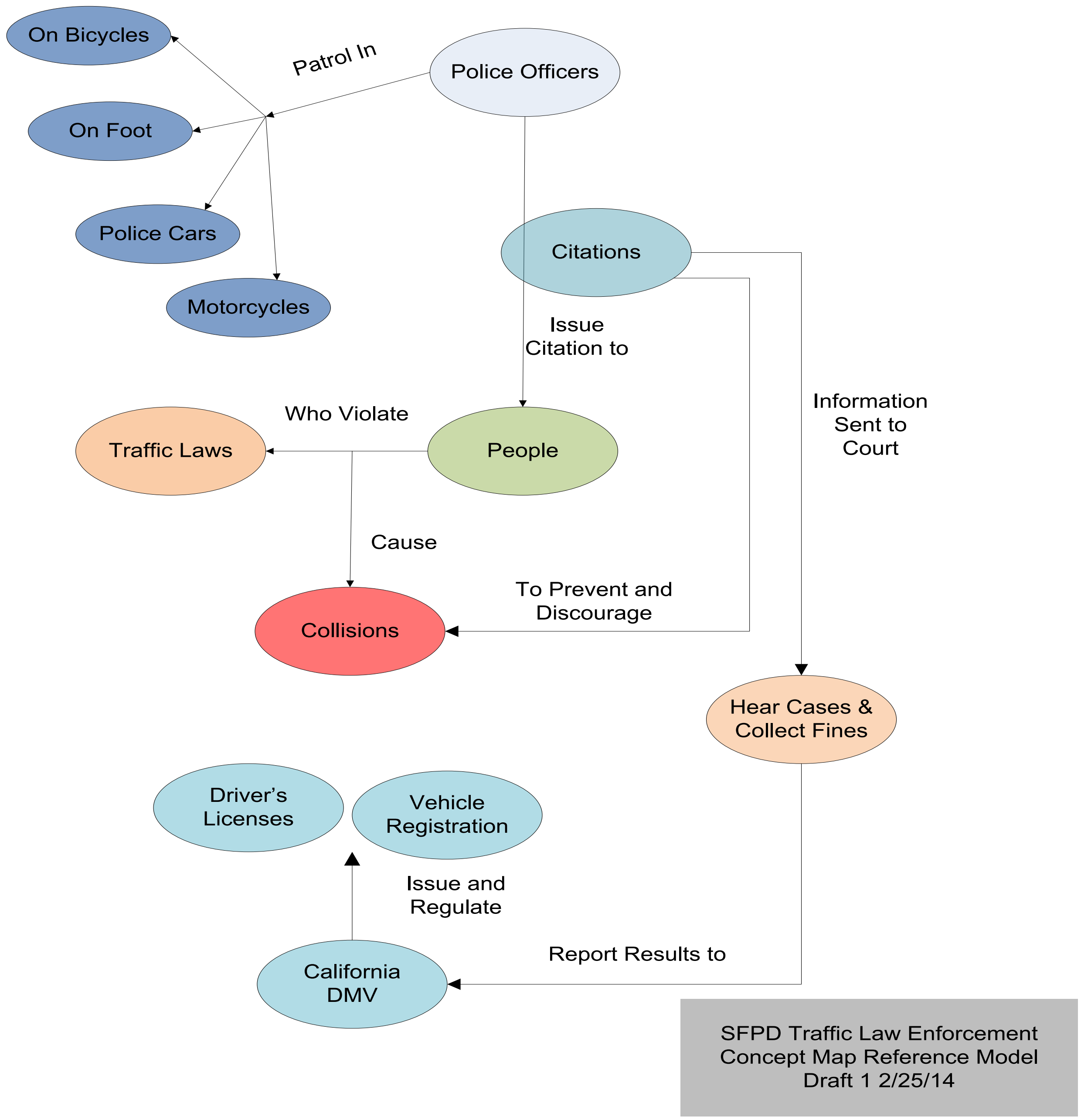


Figure 5, Concept Relationship Map

The concept relationship map in figure 5 highlights the core entity/concepts of the overall reference model of traffic citation, collision investigation and reporting, and court adjudication. This is for reference only and orientation that shows the important concepts that would be needed in any reengineering efforts.

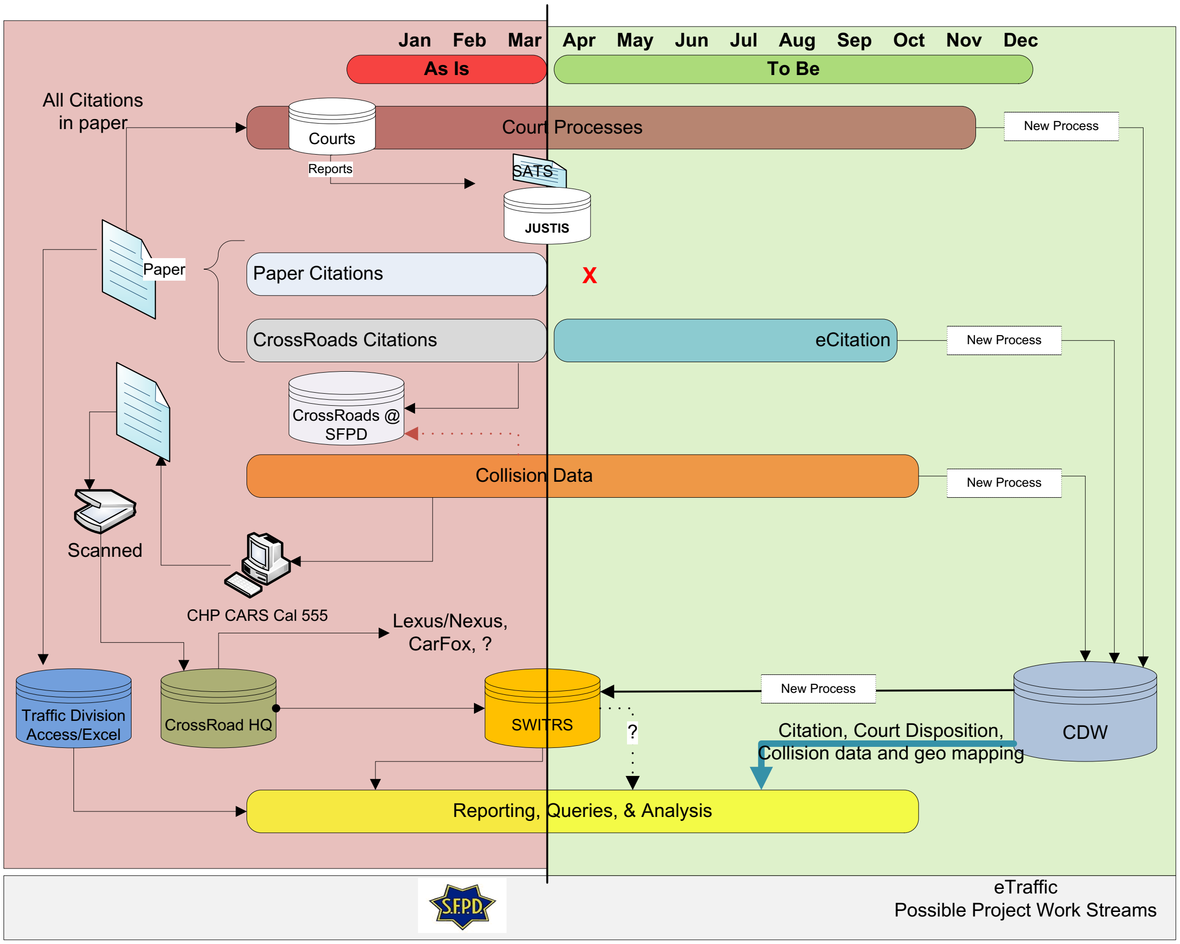


Figure 7 Possible work streams for future project

6.0 Possible Future Project Work Streams

In the current process, we have five distinct relevant data depositories

- A local SFPD and the national CrossRoads database of recent electronic citations
- A local SFPD data depository of 5 years recent accident data, and collision data from SFPD in the national CrossRoads database, captured in the scanning of the Cal 55 form.
- The traffic division's local Access-Excel system of paper citations
- Paper copies of citations in the Identification and Records division
- The California Highway Patrol 's SWITRS system hosting collision data
- The court's system holding digital citation and citation disposition data

A future project might have work streams to:

<u>A. Claw back historical citation and collision data and load into CDW</u>

<u>B. Create new or automate existing processes for digital data capture and management going forward</u>

- Capture, claw back historical citation data, for cleansing and loading into the CDW
- Capture, claw back historical collision data, for cleansing and loading into the CDW
- Automate or create new automated processes
    - Future eCitation data into CDW
    - Future Collision data into CDW
    - Automated collision data transfer with CHP and SWITRS system
    - Automate collection of citation disposition by courts
- There would be considerable benefits across police function areas beyond traffic management with full sets of historical citation and collision data in CDW, for cross analysis, data mining, and network analysis.
- Currently existing paper citation digital data, and CrossRoads eCitation digital data is not formatted or architected for easy, if any, geo-mapping in the CDW.

Part II CAUSES AND CONDITIONS

Part I of this document focused on describing the existing traffic citation life cycle and processes, concepts, relationships and interfaces with other systems. In Part II, we look briefly at a driving force behind the traffic citation life cycle analysis, pedestrian traffic fatalities in San Francisco. This is not an in depth analysis, but a quick look that hints at possible future work.

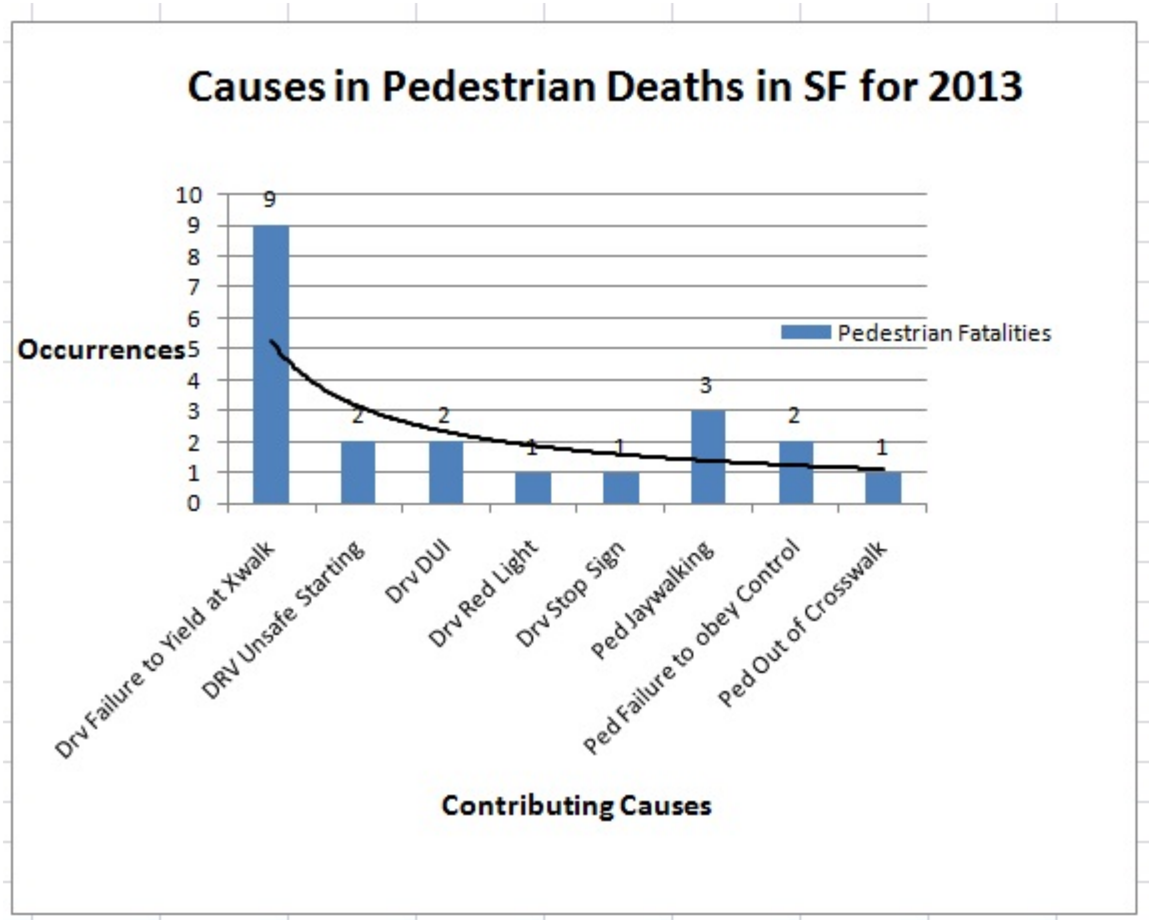
7.0 Pedestrian Fatality Analysis

It's commonly accepted that selective and targeted traffic law violation enforcement can reduce traffic accidents, including pedestrian fatalities, which has been know and applied by law enforcement agencies for decades. The first order analysis-action model provides for focusing enforcement in high accident areas and for violations that are the statistically greatest contributors to accidents and fatalities. The model and action plan are supported by collection and analysis of accident and citation data.

7.1 Pareto Analysis

A traditional early step in such an effort is the root cause analysis or Pareto analysis, in which the leading causes of the events under study are determined. This often leads to an 80:20 result where 80% of not-under-control events are caused by 20% of the causes.

Below is the Pareto chart for contributing causes of pedestrian fatalities in San Francisco for 2013. example for the causes of an automobile engine overheating. Data for the Pareto chart is gathered from simple statistical analysis of data and grouping into frequency of causes.



While this is only a single year sample, it show driver fault in 15 cases, 71%, and pedestrian fault in 6 incidents, or 29%.

7.2 Root Cause Analysis

In a fish-bone or Ishikawa diagram is similar to the Pareto analysis but is not necessarily statistically based. It may precede a Pareto analysis by indentifying anecdotal causes to be pursued in the statistical Pareto analysis.

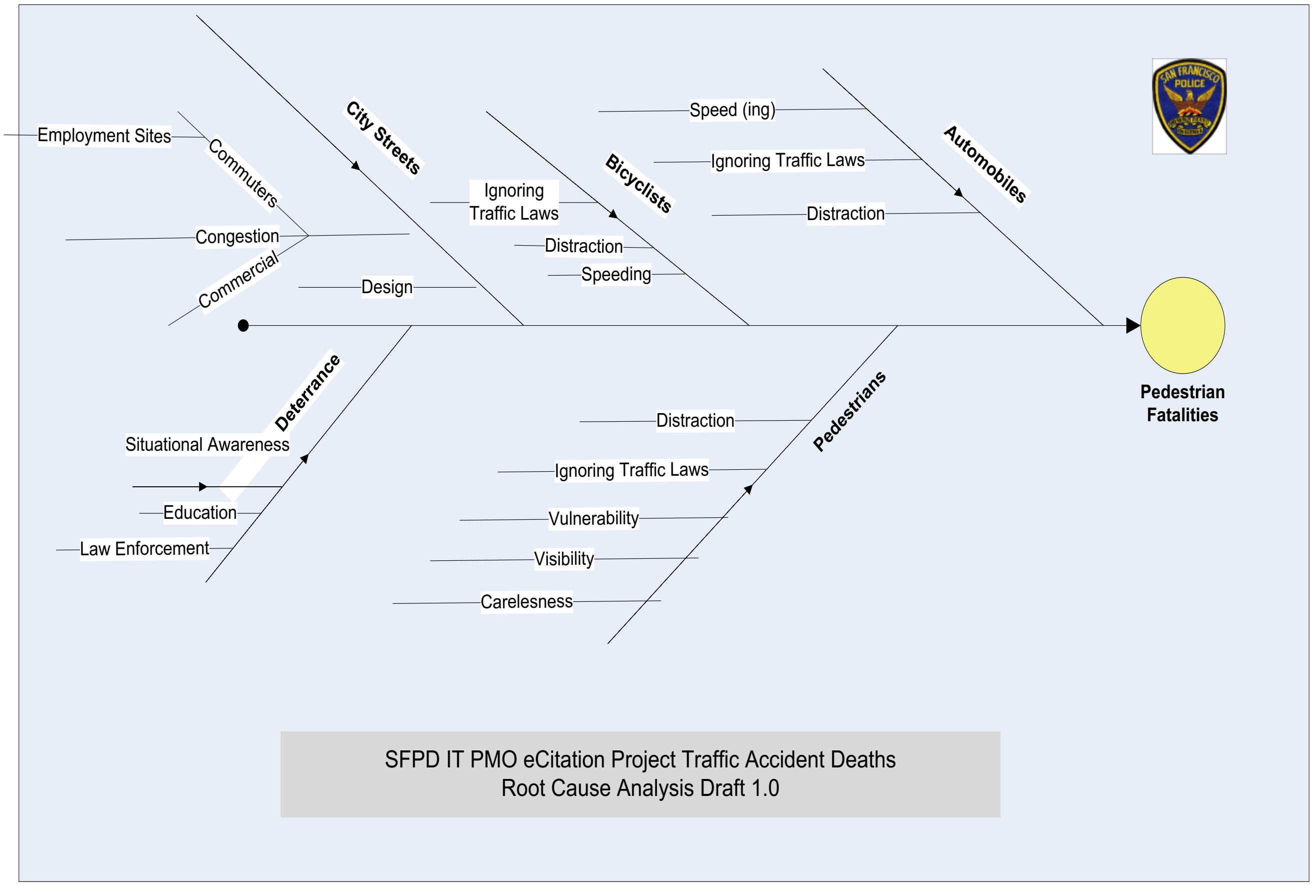
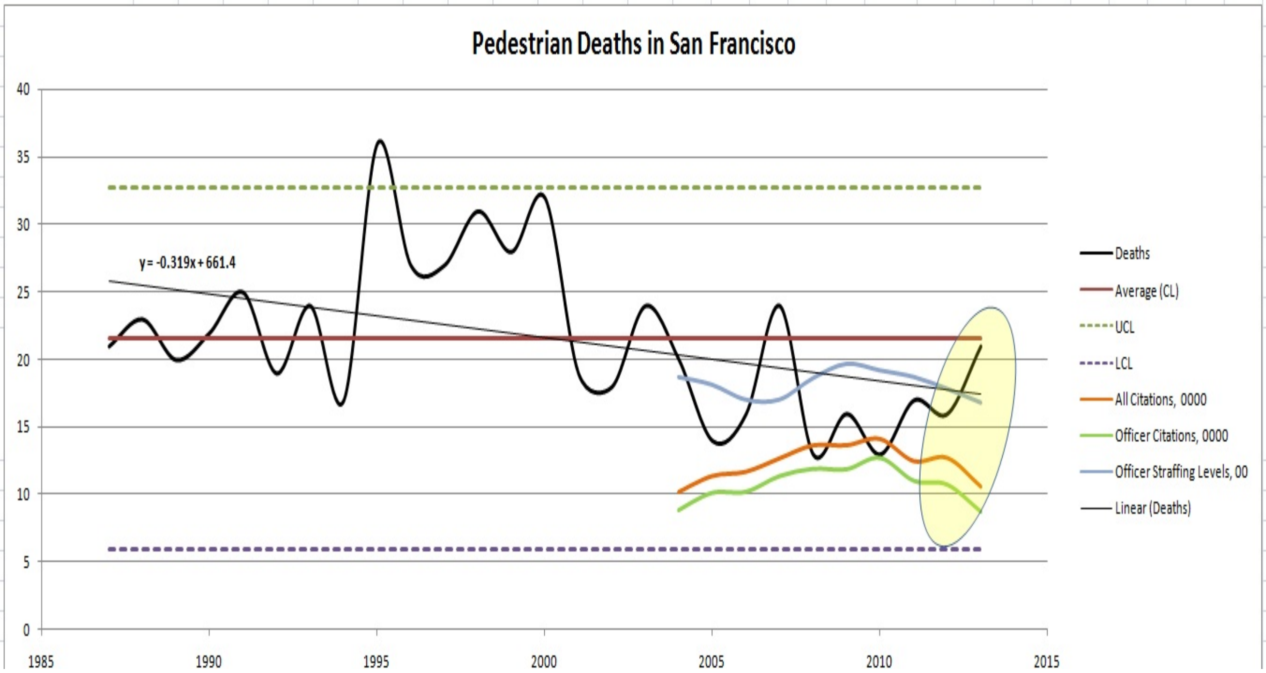


Figure 9 Root Cause Analysis – Ishikawa diagram

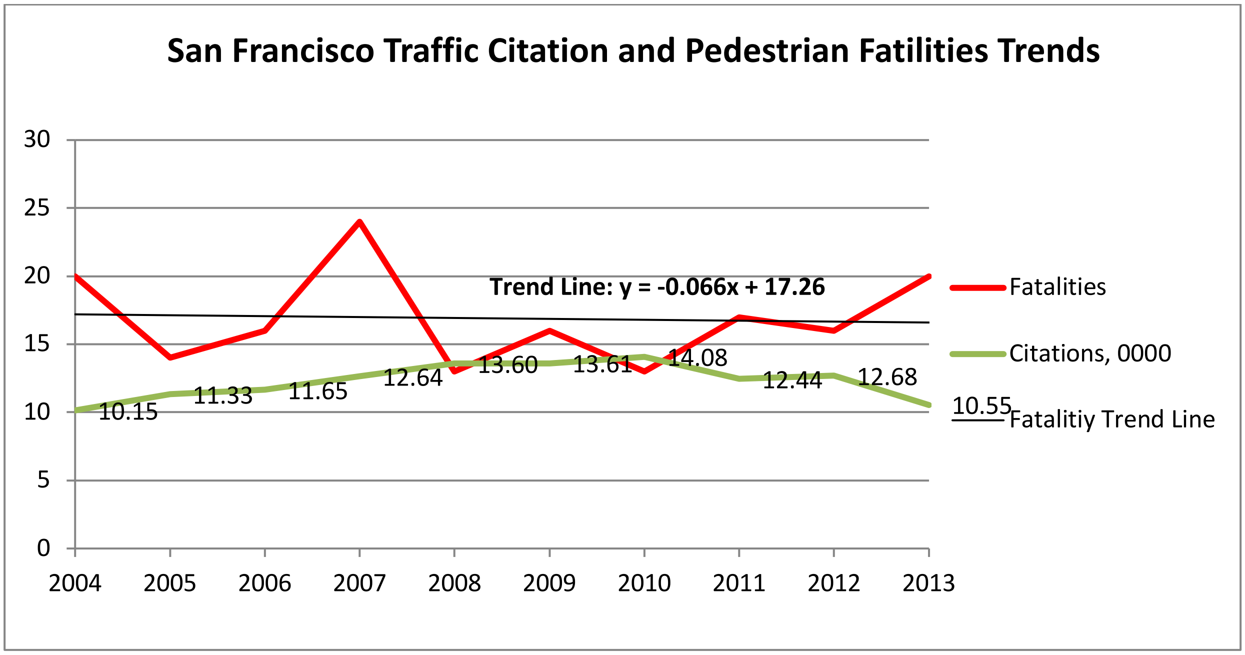
Figure 9, above, shows some anecdotal root causes in an Ishikawa diagram from an eCitation project meeting on February 15, 2014. San Francisco’s Vision Zero initiative to eliminate pedestrian traffic deaths in ten years has three elements, Education, Engineering, and Enforcement.

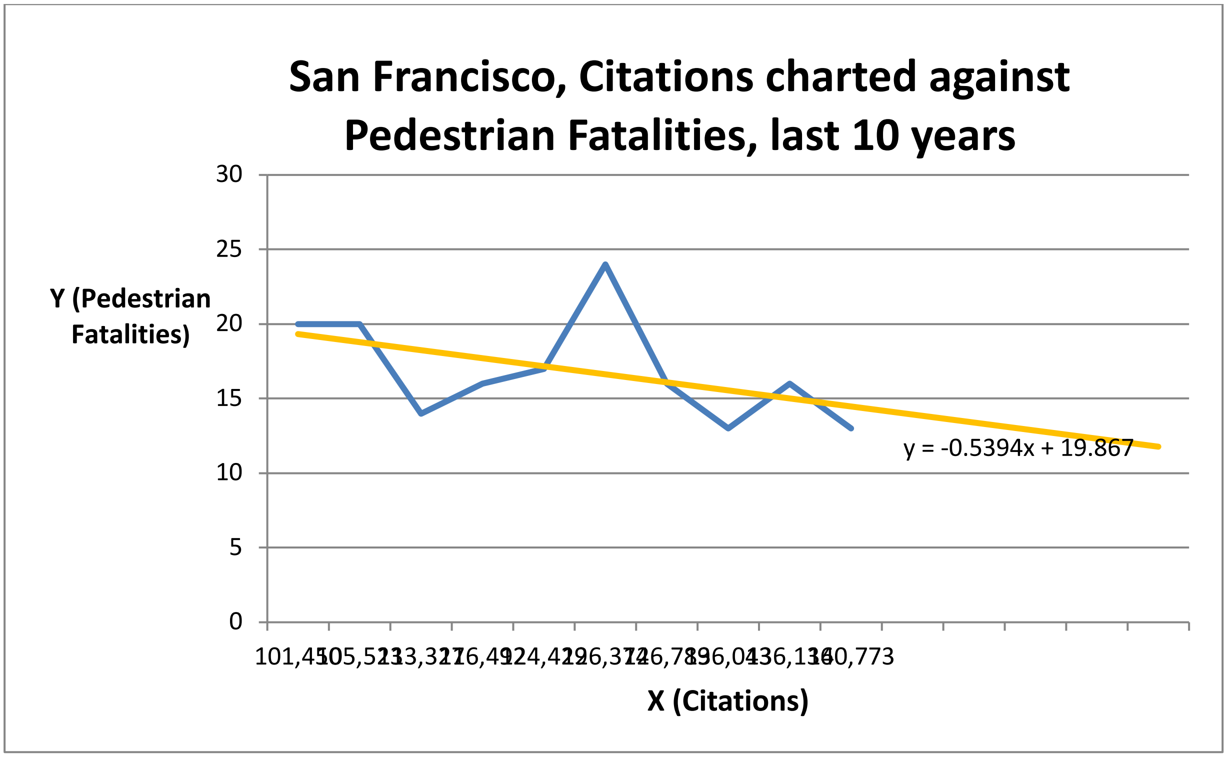
Year	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Deaths	21	23	20	22	25	19	24	17	36	27	27	31	28
Average (CL)	22	22	22	22	22	22	22	22	22	22	22	22	22
UCL	32.69	32.69	32.69	32.69	32.69	32.69	32.69	32.69	32.69	32.69	32.69	32.69	32.69
LCL	5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91
All Citations, 0000													
Officer Citations, 0000													
Officer Straffing Levels, 00													

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Deaths	32	19	18	24	20	14	16	24	13	16	13	17	16	21
Average (CL)	22	22	22	22	22	22	22	22	22	22	22	22	22	22
UCL	32.69	32.69	32.69	32.69	32.69	32.69	32.69	32.69	32.69	32.69	32.69	32.69	32.69	32.69
LCL	5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91
All Citations, 0000					10	11	12	13	14	14	14	12	13	11
Officer Citations, 0000					9	10	10	11	12	12	13	11	11	9
Officer Straffing Levels, 00					18.68	18.13	17.06	17.06	18.6	19.63	19.16	18.69	17.84	16.85



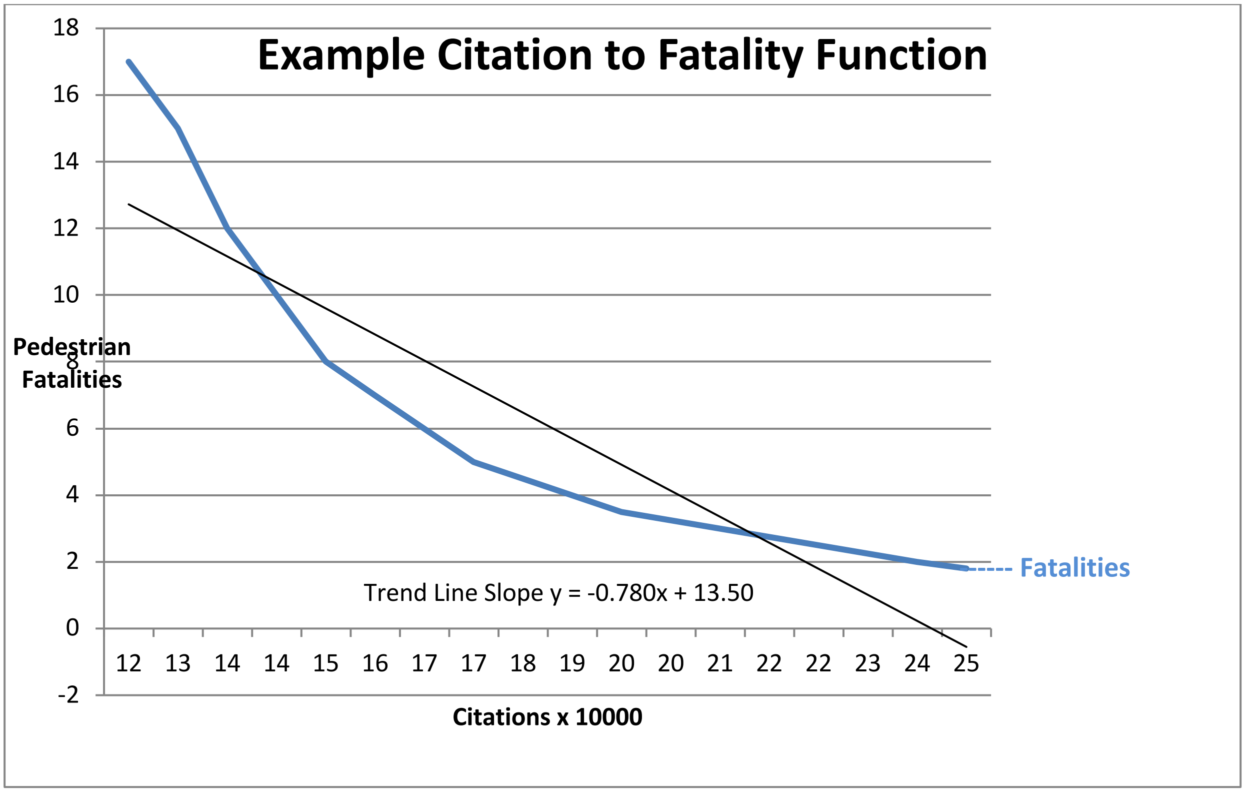
Some early analysis of historical pedestrian deaths and citations show an overall trend down in deaths, but with some large oscillations. Since around 2005, pedestrian deaths show an expected inverse relationship of pedestrian deaths to citations and officer staffing. While there is a likely correlation between enforcement level and collisions and pedestrian deaths, there are many factors involved and a direct linear one-to-one relationship is incomplete. For example, an otherwise unexplained spike in pedestrian deaths in December of 2013 might have been influenced by very unusual summer or spring like weather in San Francisco, when the usual December weather is windy, cool or cold with frequent rain and storm activity.


San Francisco Traffic Citation and Pedestrian Fatilities Trends
30
25
20
15
10
5
0
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Trend Line: y = -0.066x + 17.26
10.15
11.33
11.65
12.64
13.60
13.61
14.08
12.44
12.68
10.55
Fatalities
Citations, 0000
Fatalitiy Trend Line



Excel’s calculation of the trend slope, Y= -0.539x+19.86 is not validated.

The reader should not infer from these Excel charts a known *mathematical* function of negative pedestrian deaths from the number of citations, though such a relationship exists. Even with the apparent spike in pedestrian fatalities around 2007 and an uptick in the past two years, all data points are within the upper and lower bound (average + 3 sigma) and thus mathematically within normal variation of the pedestrian fatality rate, and the overall trend of pedestrian deaths is down over time. Data examined so far does show a negative correlation between citations and pedestrian fatalities, which is expected. No sensitivity analysis has been attempted, or introduction of other variables than citations and pedestrian fatalities. A dynamic model would be suitable for this.



If there were a known linear mathematical function f(fatalities) = x(citations), it might look like the above chart where approximately doubling the current level of citation would reduce fatalities to zero.

7.3 Dynamic Modeling Pareto analysis and root cause analysis depend on and depict historical data about the system or events of interest. A good historical data set can be used, too, for extrapolation. This is most effective when the process can be expressed in a mathematical function; but in many cases a direct mathematical function for cannot be found, only historical correlations, which are nonetheless useful.

In the post WWII era, the modern age of technology emerged. The war period saw nuclear fission and the atomic bomb, modern digital computers, robotics, advanced complex systems engineering, modern project management principles, the beginnings of near earth space travel, and astonishing break troughs in medicine and cybernetics.

This second half of the 20th Century also saw the emergence of "Systems Thinking" and systems engineering, the former popularized by Peter Senge (1990) in his book *The Fifth Discipline*, though systems engineering and systems thinking date back to von Bertalanffy's *General Systems Theory* in 1934. Von Bertalanffy insight and work showed how there are repeating patterns of behavior, principles, and characteristics (such as exponential grown, steady state, homeostasis, and open and closed system behavior, and the fundamental principle of positive and negative feedback loops, and accumulators) across many ‘system’ disciplines, such as biology, cybernetics, mechanics, and physics, just to name a few.

Jay Forester of MIT began developing his ‘dynamic modeling’ discipline in the 1960s, which was brought to the world scene in 1972 with Donella Meadows lead in publishing *The Limits to Growth*, in conjunction with her work with the Club of Rome and development of the *World 3*, computer model.

Since then, dynamic modeling has proven very successful in modeling complex systems in different discipline areas such as economics, weather, manufacturing, supply chain, air traffic control, biology, medicine, and the delivery of health care. Nonetheless, dynamic modeling has limitations in always being capable of generating models that reflect real word dynamics accurately.

A few fundamental principles of complex dynamic systems behavior are very useful though, the first being push back, or a systemic reaction counter force to any force exerted within the system. These are depicted in dynamic modeling as negative feedback loops. Positive feedback loops tend to reinforce the existing trend. Another important principle is that the effects from a given force may be displaced in time and place from the original force, in large systems sometimes years. These delays in visibility of feedback often cause oscillations in accumulation and flows within a system. In one anecdotal case, a car speed down a street not usually used by the driver, in order to avoid a sobriety test point and hit a pedestrian.

Two graphics are shown below that show possible direction for dynamic analysis of ‘automobile and pedestrian traffic system.’ We should remember that a ‘system’ is not just some human made machine or process, but can be any area of behavior or process of interest that we want to investigate. The system boundaries are chosen by those investigating. Thus, in a mountain and valley geological area, the Botanist’s system is the plants and animals on the ground, the Forester’s system is the trees, ground, and Geologist’s system is the solid earth of the mountains, layers of sentiments and mineral deposits.

Thus for San Francisco’s Vision Zero initiative, the system of interest is the city streets, automobile, bicycle, motorcycle, mass transit, and pedestrian traffic, traffic controls (traffic lights, stop signs, street traffic direction controls, speed limits, etc.), and police traffic law enforcement. All of these system elements come together successfully for safe and easy traffic flow, and unsuccessfully at times in traffic collisions and pedestrian deaths.

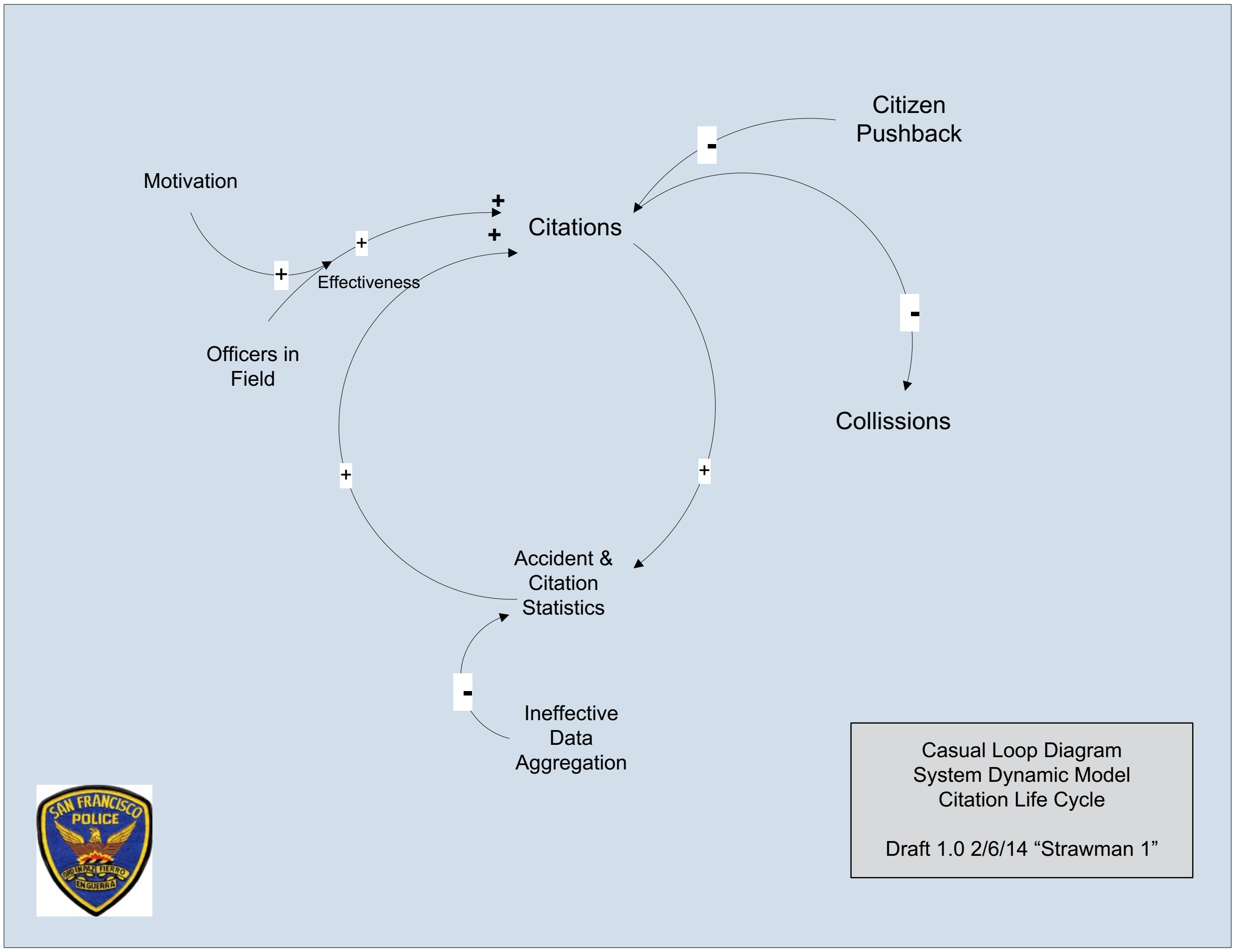


Figure 10 Casual Loop Diagram

<u>7.3.1 Casual Loop Diagram</u> In systems dynamics modeling, the first step is often to mark up a casual loop diagram of the system of interest, showing the events, or accumulators and systemic reinforcing or countering forces. For example, there may be a citizen push back force against increased traffic tickets that may be steady, or growing, or have a sudden start when a certain point of build up is reached.

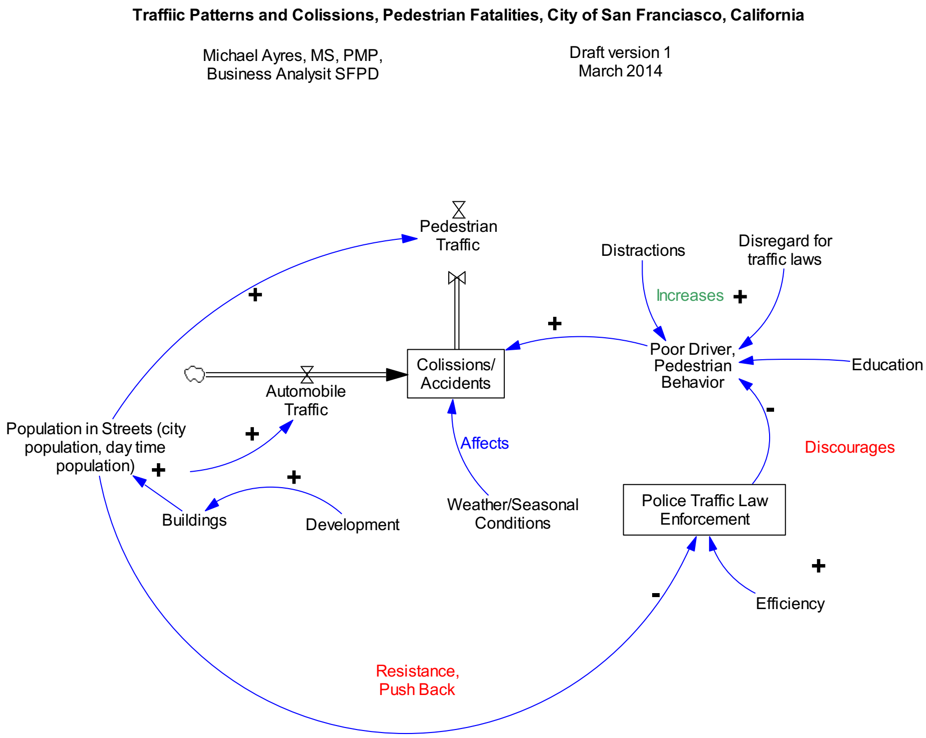


Figure 11, Dynamic Model for Traffic Collisions a Pedestrian Deaths

7.3.2 System Dynamics Model

After the casual loop diagram has identified some initial key flows (forces), feedbacks, and accumulators (events, or stocks), the dynamic model can be build, tested and refined. Without going into any detail, when a dynamic model is run data is output in graphs and tables showing the behavior of the model over time. These can be simple or very complex with dozens or hundreds of variables, feedbacks, but usually fewer stocks and flows.

Figure 12 Dynamic Model Output

In the above figure of a dynamic model output showing wolf and moose populations and variations over time, we see the changes of each over time and the relationship of change over time to each other. Wolfs do interact with Moose, as predator and prey, thus a human intervention to alter the wolf populations would have an affect on the Moose population, which may have an affect on yet another element in the ecological system and balance. An increase in population increases density, which increases pedestrian and vehicular traffic, which leads to an increase in traffic accidents, probably, all other things being equal.

7.4 Concluding Notes

"There is not a single strategy that will reduce pedestrian fatalities – it is a comprehensive approach employing engineering, education and enforcement **with the focus on both driver and pedestrian.**"[1]

Future work on the overall citation and traffic collision management and fulfillment of the city's "Vision zero" of eliminating pedestrian traffic collision deaths in the future could benefit from a deeper analysis of causes and relationships of various contributing forces and factors. The system dynamics discipline has proven effective over recent decades in modeling and predicting overall systemic behavior when individual forces are changed. With a system dynamic model, what-if scenarios can be tested. The classical example of system dynamic behavior is the unforeseen consequences of human intervention in species balance in a particular habitat. Reducing the coyote population in an area might please ranchers who were losing some livestock, but the reduced coyote population might allow an increase in a coyote prey population, which then might attract another predator, which might cause an imbalance in another relationship, and so on.

More relevant to pedestrian death reduction efforts, in a recent pedestrian injury accident, the car which struck the pedestrian had taken another route to avoid a sobriety check point and drove fast in an area that was not known to be a high pedestrian accident area.

Might putting speed damper bumps in a right turn lane at a high accident intersection lead to an increase of traffic (to avoid the slow turn corner) to another street with a elementary school with many children pedestrians, leading to a reduction here and an increase there?

A cursory examination of a data set of 41,000 traffic citations issued in San Francisco in 2013 found that approximately 26,000 or 62% were issued to San Francisco residents. Of these, about 16% were issued to those aged between 20-30 years old. Were this figure higher, say 35%, one might focus education toward this group. If an over 55 years of age have a higher citation rate, one might adjust education accordingly.

More interesting would be breakouts like this on accident rate.

While complex dynamic system behavior can be difficult to manage and predict, dynamic modeling does provide a deeper and more useful basis for systemic changes.

Complex non-linear dynamic systems, like vehicle and pedestrian flow across city streets and subsequent collision, can be more complex to understand and control that initial appearances or mental models, which can focus on event oriented world view and event level analysis and solutions that fail to include complexity, negative and positive feedback loops and the principle in dynamic systems that effects from causes are often delayed in time and dislocated in space.

[1] National Center for Statistics and Analysis (NSCA). (April 3013). "Pedestrian Roadway Fatalities." US Department of Transportation, National Highway Safety Administration. Springfield, VA. USA.