National Surface Transportation Safety Center for Excellence

SAFETY DEVICES AND TECHNIQUES THAT ENHANCE DRIVER PERFORMANCE

Virginia Tech TRANSPORTATION INSTITUTE

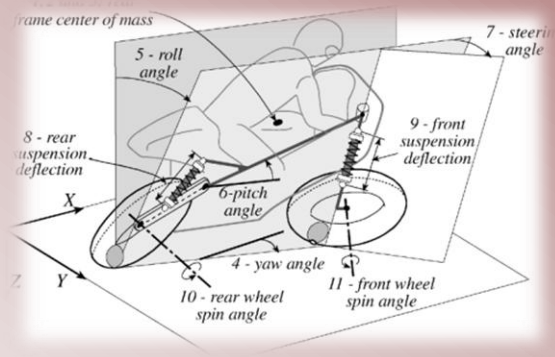
Driving Transportation with Technology

Overview

- Motorcycles naturalistic preparation
- 100 car driver ID assessment
- Using naturalistic data to assess driver behavior in crash “hot spots”
- Road side naturalistic data
- Public Access Website
- Texting

Naturalistic Observation of Motorcycle Riders

- Goal: Pursue methods (sensors and analyses) to support naturalistic research into motorcycle crash causation.
  - Questionnaires assessing instrumentation acceptance
  - Refining and developing additional instrumentation and enclosures
- Completed a NHTSA funded feasibility study to conduct motorcycle naturalistic research
- Kicked off MSF funded a three site Naturalistic Motorcycle study
- Example Bike in Demo area

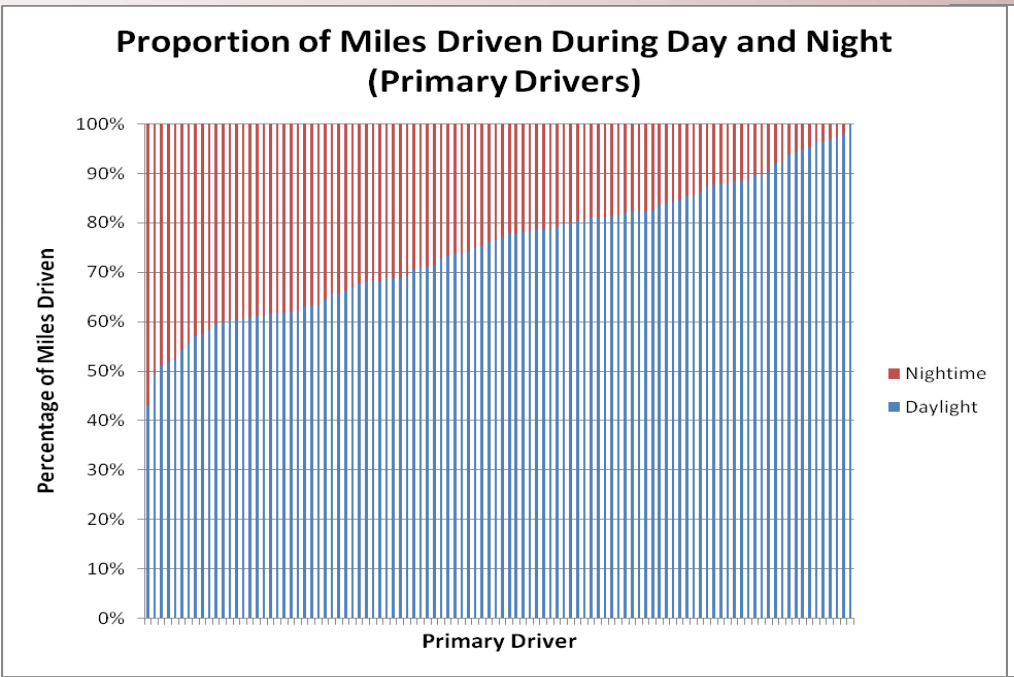


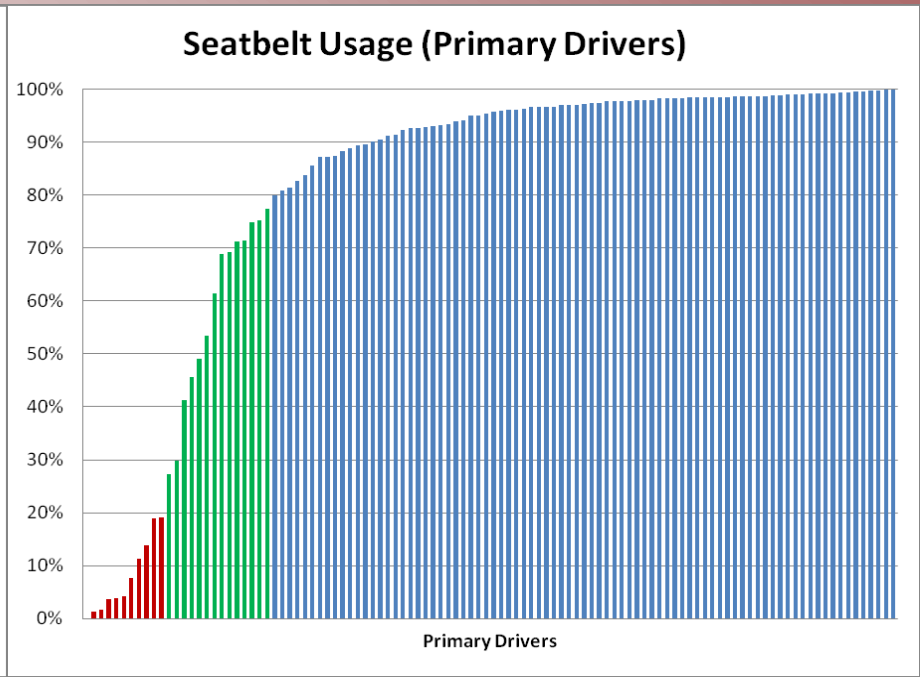
100 Car Driver ID Reanalysis

- Project goal was to build a complete trip file inventory for the 100-Car dataset.
- Each trip file in the 100-Car dataset was viewed by data reductionists
  - Driver ID (with new IDs created as new secondary drivers were found),
  - Ambient Lighting,
  - Driver Seatbelt Usage,
  - and an assessment of video operations/quality.
- Improves power if you know who is driving

Key Results

	Primary Drivers	Secondary Drivers	Total
# of Drivers	108	299	407
Total # of Trip Files	139,367	17,270	156,637
Total # of Driving Days	24,189	4,708	28,897
Total Miles Driven	1,119,202	137,376	1,256,578





Driver Behavior in Crash Hot Spots

Can Naturalistic Data Provide Insights if there is no Crash or Near Crash?

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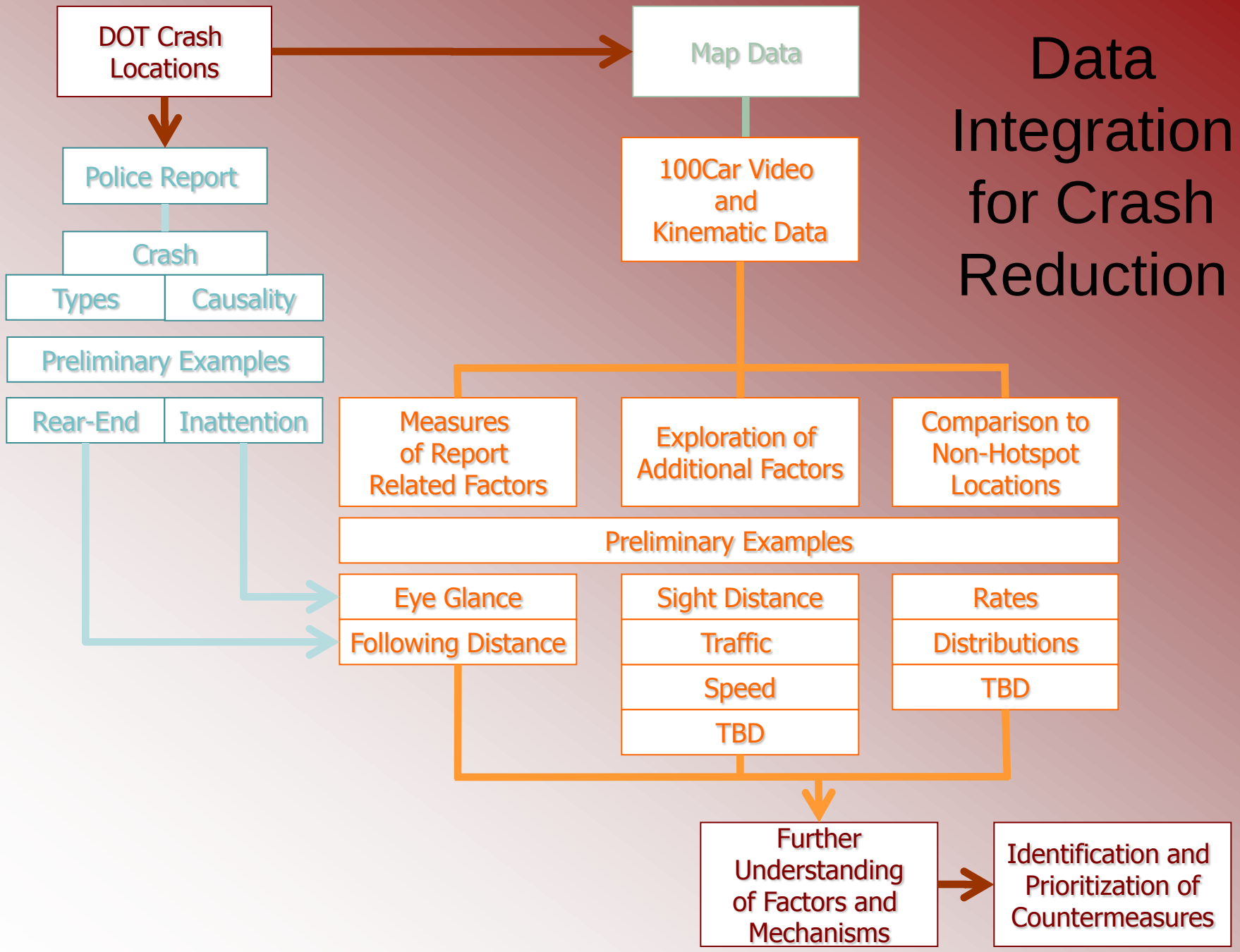
Data Integration for Crash Reduction



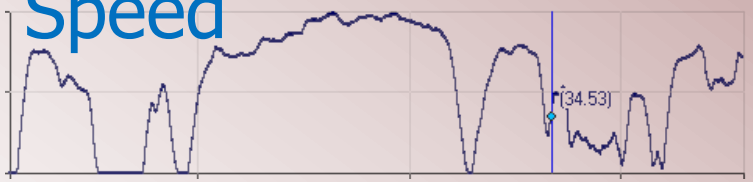
Integration of GIS Techniques with Naturalistic Data

- Maps provide a reference for integration of data from many sources.
- Provides more complete picture of the surroundings through which the vehicle passes.
- Permits investigation of interactions between the driver and many factors.
- Permits isolation of many sources of variance in driver behavior and performance.

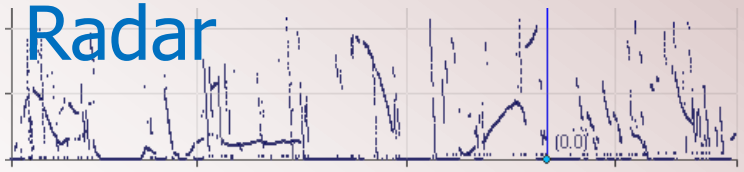
Urban Areas

Precipitation

Speed

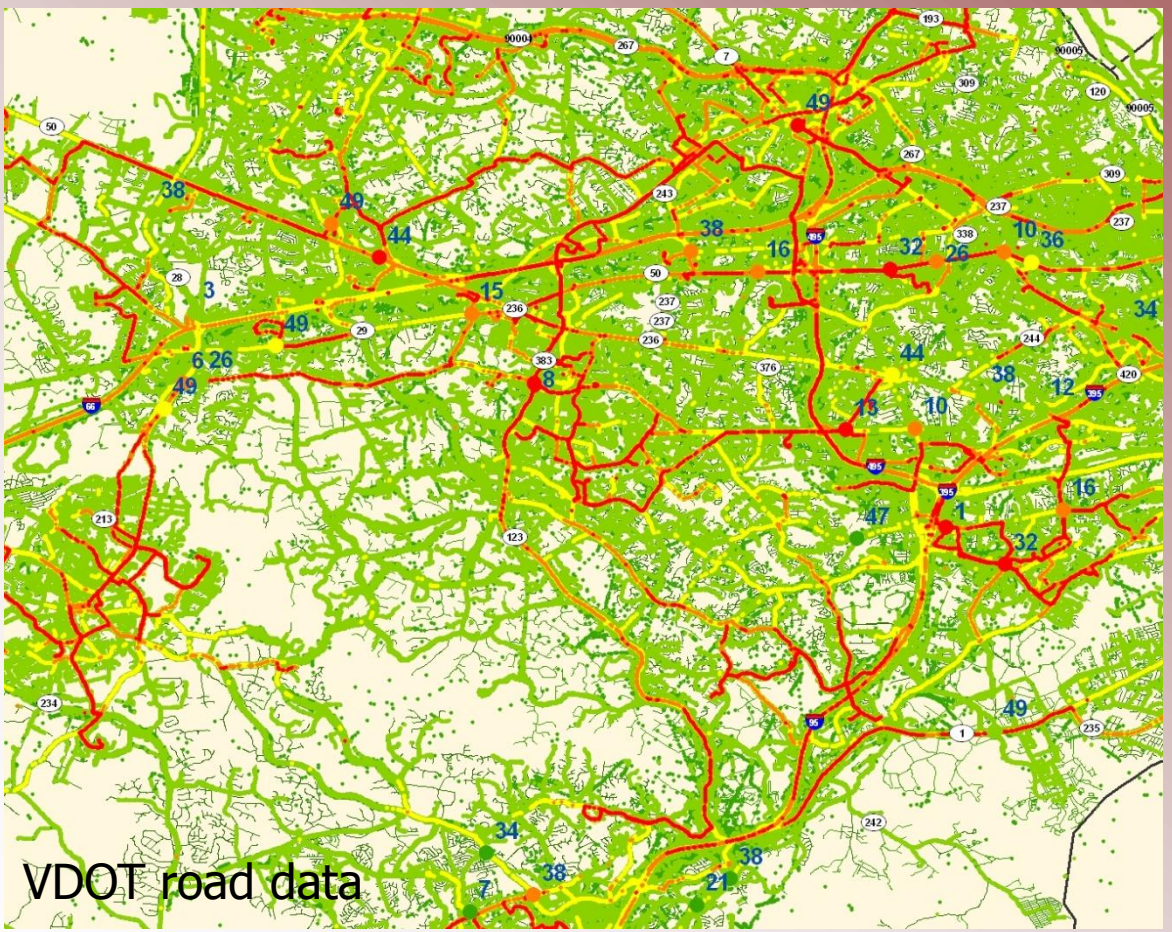


Radar



Routes

Preprocessing for Location Based Analyses



- Down-sampling of route data
- Followed by location based summary of routes

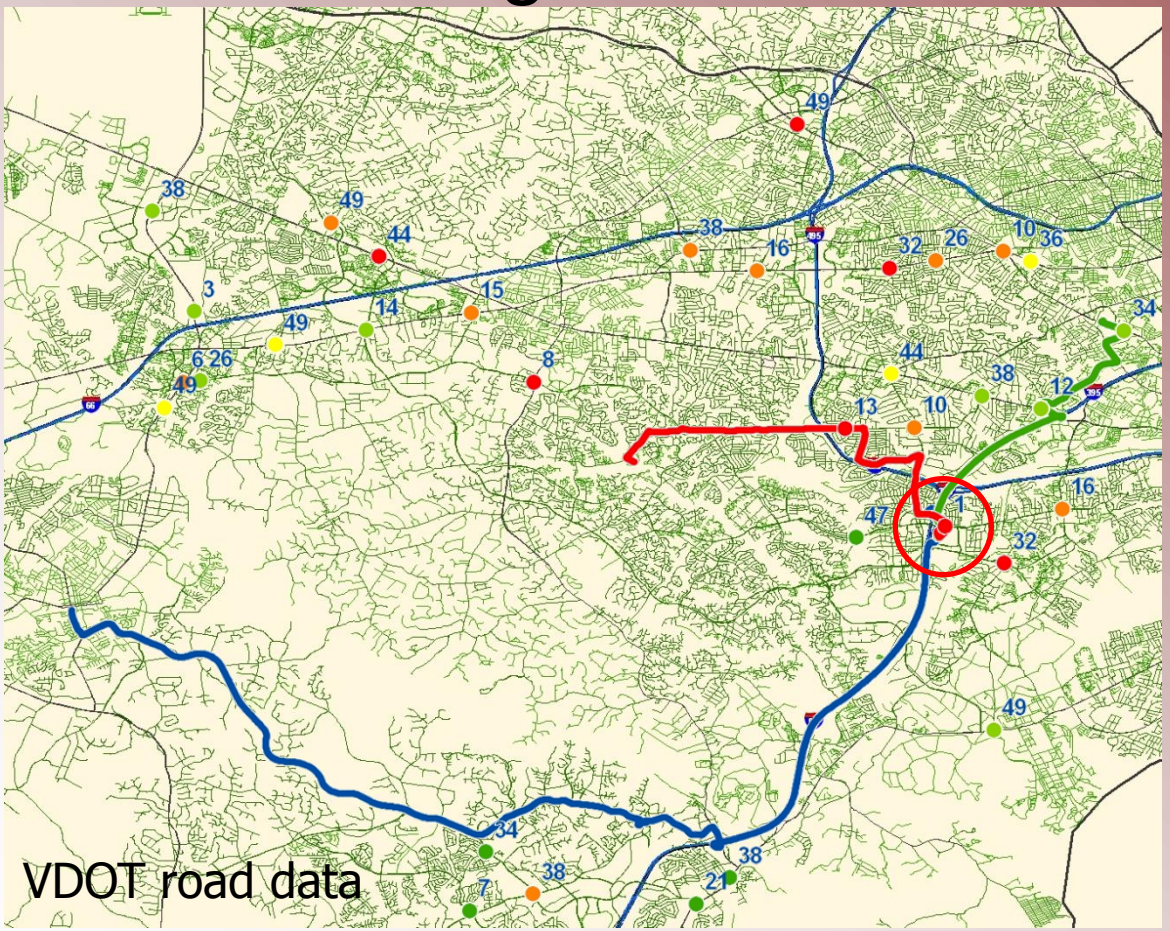
Permits:

- Rapid visual review and exploration
- Faster analyses
- Within driver or between driver comparisons while holding location constant

100-Car trips down-sampled to 81 million “bread crumbs”, then processed to summarize number of trips through area:

1 - 2-99 - 100-199 - 200-299 - 300+

Example: Analysis of Trips Through a Location



Intersections ranked by rate of injuries & fatalities then coded by number of 100-Car trips through intersection

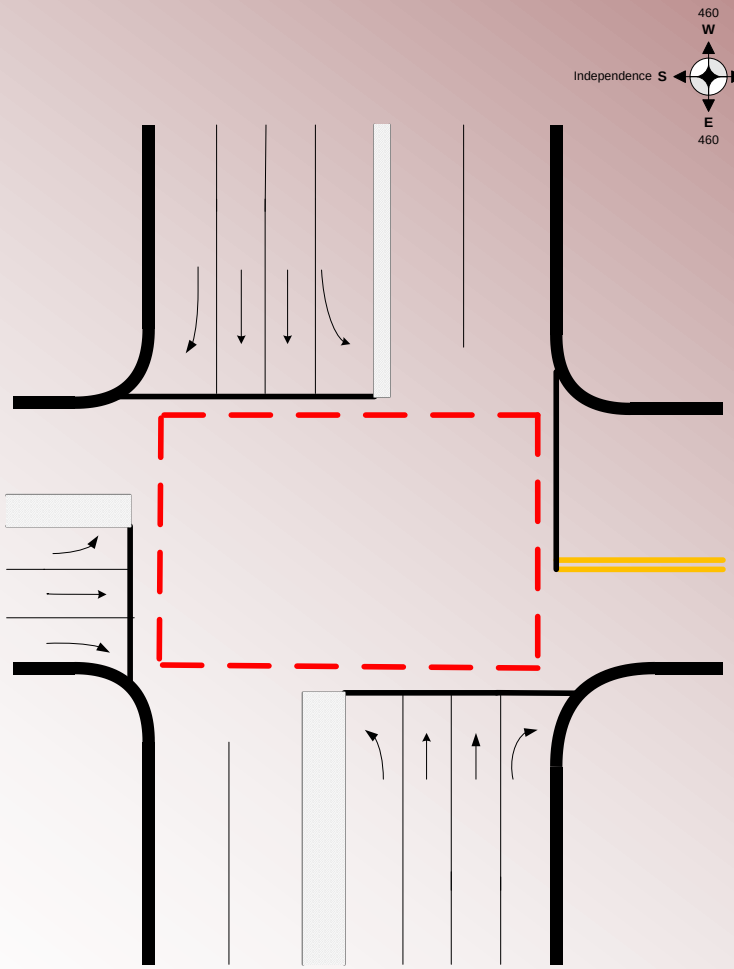
- 1-478
- 479-848
- 849-1143
- 1144-1646
- 1647-3445

Results and Future

Results: Not as insightful as hoped

Future: Still think the approach has merit and plan to try again with SHRP2 data

Data Mining of Roadside Observational Data at Intersections



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Data Mining of Roadside Observational Data at Intersections

- Goal
  - Identify factors that are related to violation propensity at the three CICAS-V signalized intersections.
  - Identify factors that lead to higher violation rates at the Independence intersection

Location	Crossings	All Violations		Only LTAP and SCP Violations	
		Frequency	per 100k crossings	Frequency	per 100k crossings
Depot	1,159,846	2,077	179	713	61
Independence	1,341,872	5,098	380	2,162	161
Peppers Ferry	3,018,456	914	30	871	29
Total	5,520,174	8,089	147	3,746	68

Violation Risk Across all Intersections

Odds Ratio Estimates for Straight Crossing Path Maneuver			
Effect	**Point Estimate**	**95% Wald Confidence Limits**	
location df vs if	**0.233**	**0.186**	**0.291**
location pf vs if	**0.203**	**0.166**	**0.248**
vtype bus-truck-trailer vs car-van	**3.069**	**2.116**	**4.453**
vtype pickup-suv vs car-van	0.921	0.799	1.062
lvcb LV Near Violation vs LV Compliant	3.175	0.964	10.459
lvcb LV Violation vs LV Compliant	1.269	0.298	5.398
lvcb No LV vs LV Compliant	**1.301**	**1.014**	**1.669**
favcb FAV Near Violation vs FAV Compliant	0.686	0.346	1.358
favcb FAV Stopped vs FAV Compliant	**0.550**	**0.375**	**0.805**
favcb FAV Violation vs FAV Compliant	0.638	0.317	1.286
favcb No FAV vs FAV Compliant	1.209	0.901	1.621
weather cloudy vs clear	**6.235**	**4.496**	**8.647**
weather rain & fog vs clear	1.098	0.743	1.623
Time to intersection @ yellow onset	**0.741**	**0.676**	**0.813**
Tvol	1.002	1.000	1.003
Diffspeed	**1.088**	**1.064**	**1.112**

Public Access to VTTI Data

www.access.vtti.vt.edu
forums.vtti.vt.edu

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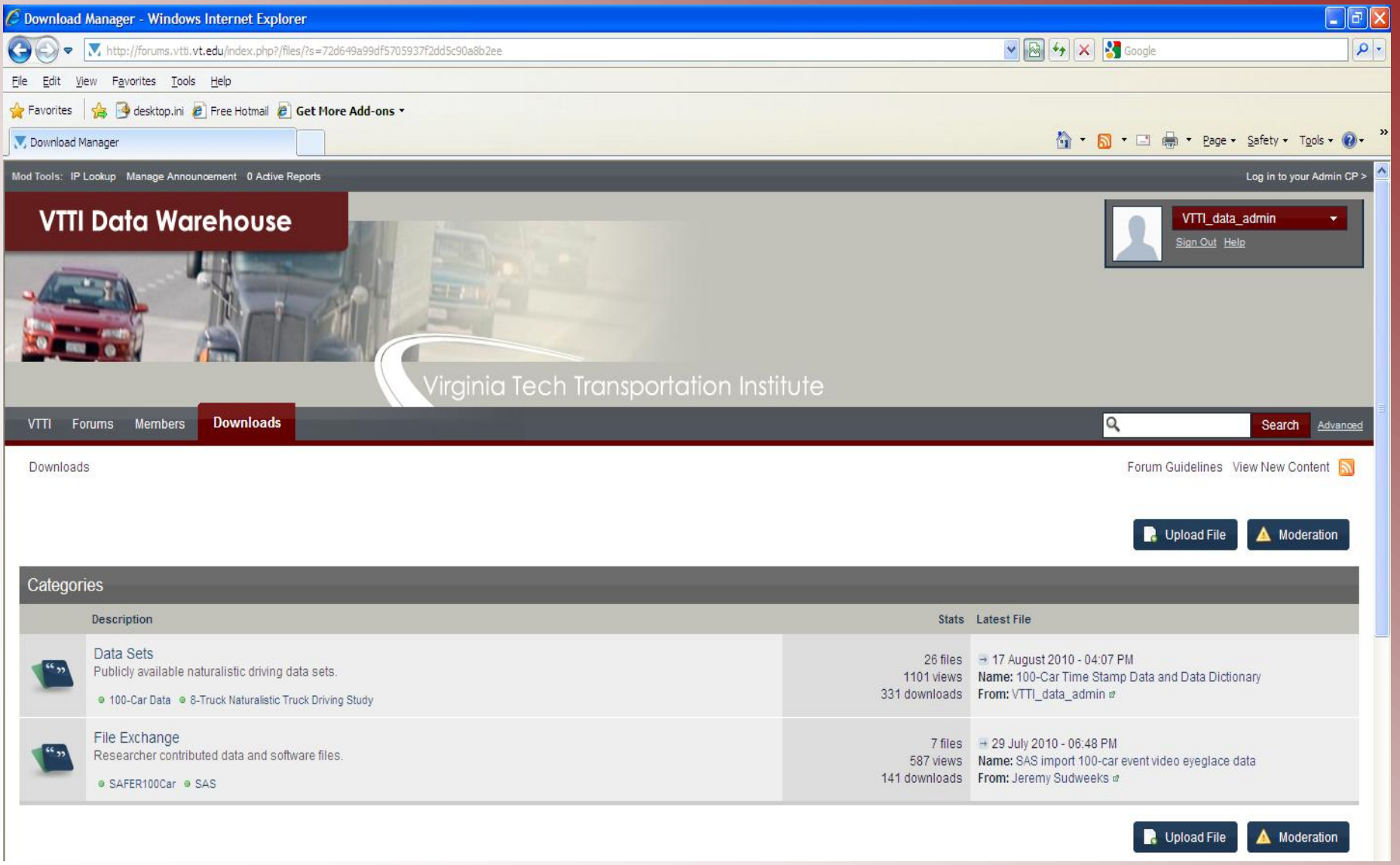
Project Overview

- Goal
  - Provide public access to VTTI maintained datasets
  - Develop service processes and support elements
- Status
  - Datasets have been released
  - Support elements have been developed
  - Currently in maintenance phase

Content Delivery

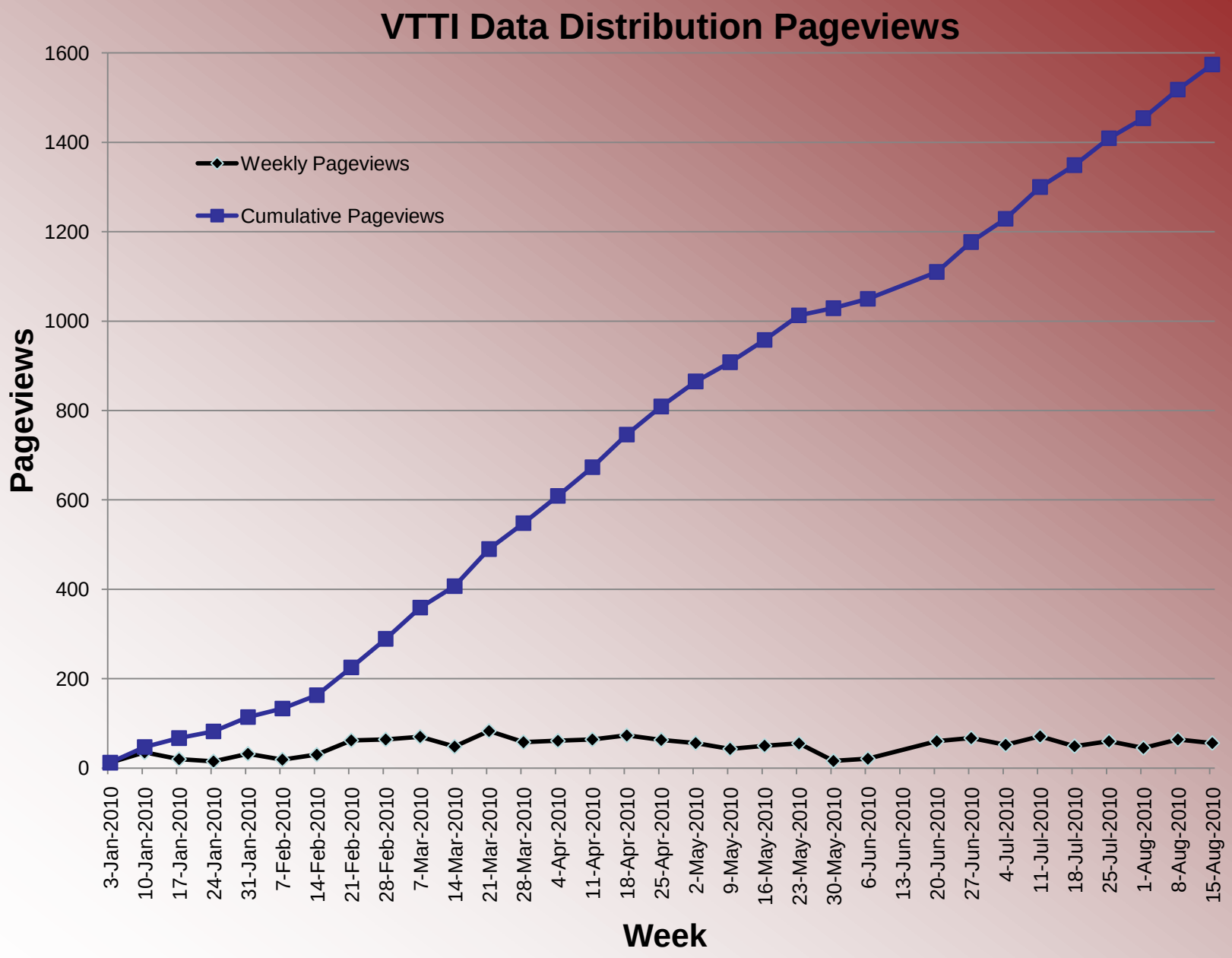


Currently Available Content [Downloads]

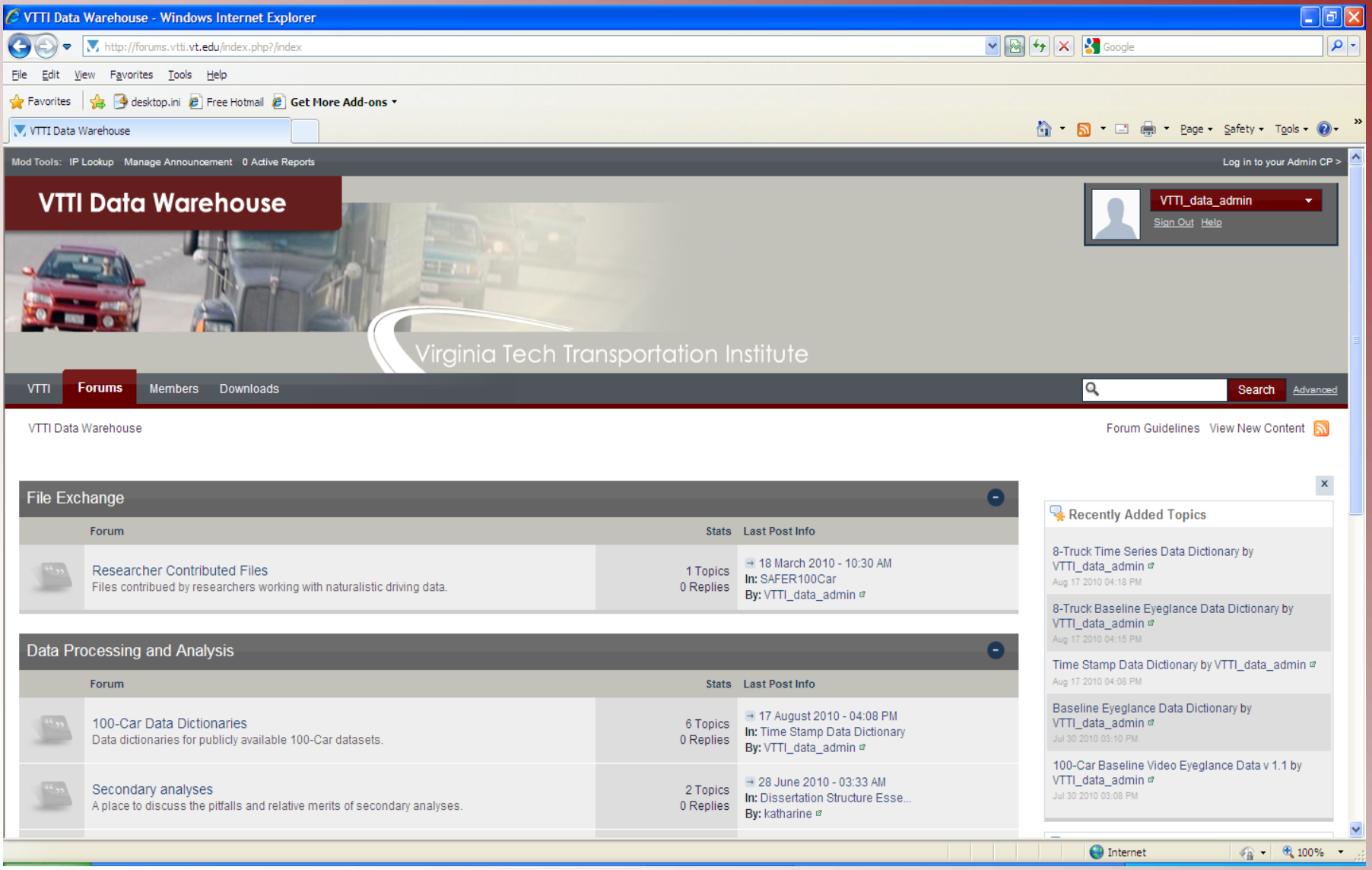
100-Car Data	8-Truck	User Contributed
Event question reduction [33]	Event question reduction [6]	SAFER100Car [71]
Event eyeglance [24]	Event eyeglance [5]	Various SAS files [72]
Event kinematic [29]	Event kinematic [5]	
Baseline question reduction [29]	Baseline question reduction [5]	
Baseline eyeglance [11]	Baseline eyeglance [3]	
Sensor status [19]	Sensor status [2]	
Event narratives [29]	Event narratives [7]	
Baseline kinematic [NA]		
Event & baseline timestamps [13]		

Website Usage

Pageviews


VTTI Data Distribution Pageviews
Weekly Pageviews
Cumulative Pageviews
Pageviews
0
200
400
600
800
1000
1200
1400
1600
3-Jan-2010
10-Jan-2010
17-Jan-2010
24-Jan-2010
31-Jan-2010
7-Feb-2010
14-Feb-2010
21-Feb-2010
28-Feb-2010
7-Mar-2010
14-Mar-2010
21-Mar-2010
28-Mar-2010
4-Apr-2010
11-Apr-2010
18-Apr-2010
25-Apr-2010
2-May-2010
9-May-2010
16-May-2010
23-May-2010
30-May-2010
6-Jun-2010
13-Jun-2010
20-Jun-2010
27-Jun-2010
4-Jul-2010
11-Jul-2010
18-Jul-2010
25-Jul-2010
1-Aug-2010
8-Aug-2010
15-Aug-2010
Week

Community Access



Next Steps

- Community development
  - Encourage users to participate in threaded discussions
  - Encourage users to contribute content to the community
    - Additional data such as derived measures
    - Algorithms or code used in analysis

- Citations
  - Develop a listing of publications that cite VTTI naturalistic studies or VTTI datasets
  - Encourage users to contribute citations

SHRPII Rodeo and Pilot Data

- Proposed to TRB for VTTI data portal to provide access to SHRP II rodeo and pilot data

- The following types of files will be made available:
  - Time series data including measures from the vehicle network, accelerometers, and GPS
  - Video files
  - Calibration (“gold standard”) datasets
    - Differential GPS
    - Crossbow triaxial accelerometer

- Discussion thread will be developed and moderated

Assessment of Texting

- Goal: Test driver performance when texting using handheld phone and an in-vehicle system (Ford SYNC)
  - Vehicle system reads incoming messages aloud, permits sending "canned" replies

- 20 participants drove on the Smart Road sending & receiving messages using both personal mobile phone and the vehicle system

Texting Results

Handheld Sending:

- Longer task durations
- Higher mental demand
- More frequent, longer glances
- Degraded steering measures

Handheld Receiving:

- Higher mental demand than baseline
- Longer max duration glances than baseline, over 2 seconds

Vehicle System Sending:

Better than handheld, but:

- Longer eyes-interior time than baseline
- Higher mental demand than baseline

Vehicle System Receiving:

- No differences found from baseline

Older drivers had more performance degradation when text messaging

- **Currently under review for publication to *Accident Analysis & Prevention***