



PTV GROUP

the mind of movement

**PTV OPTIMA
AND SAFETY SMART TRAFFIC
CONTROL FOR SMART CITIES**

www.ptv.com



**CAN ROADS BE
ONE STEP AHEAD?**



SMART TRAFFIC MANAGEMENT WITH PTV OPTIMA

OUR SOLUTION IS A DYNAMIC TRAFFIC CONTROL TOOL FOR REAL-TIME DATA FUSION AND TRAFFIC PREDICTION

Provides:

- Complete overview of your roads and PT
- Speed and flow and KPI evaluation everywhere
- Predict future effects for the next few Hours or Days
- Evaluate response strategies within the next 5-120 minutes”
- Calibration in real-time - KPIs continuously collected
- “From a reactive to a proactive approach to traffic management and info-mobility”
- “Provide reliable, on-time, useful traveller information”
- Emergency/ Disaster Plan Mitigation

DATA FUSION AND AMLIFIER

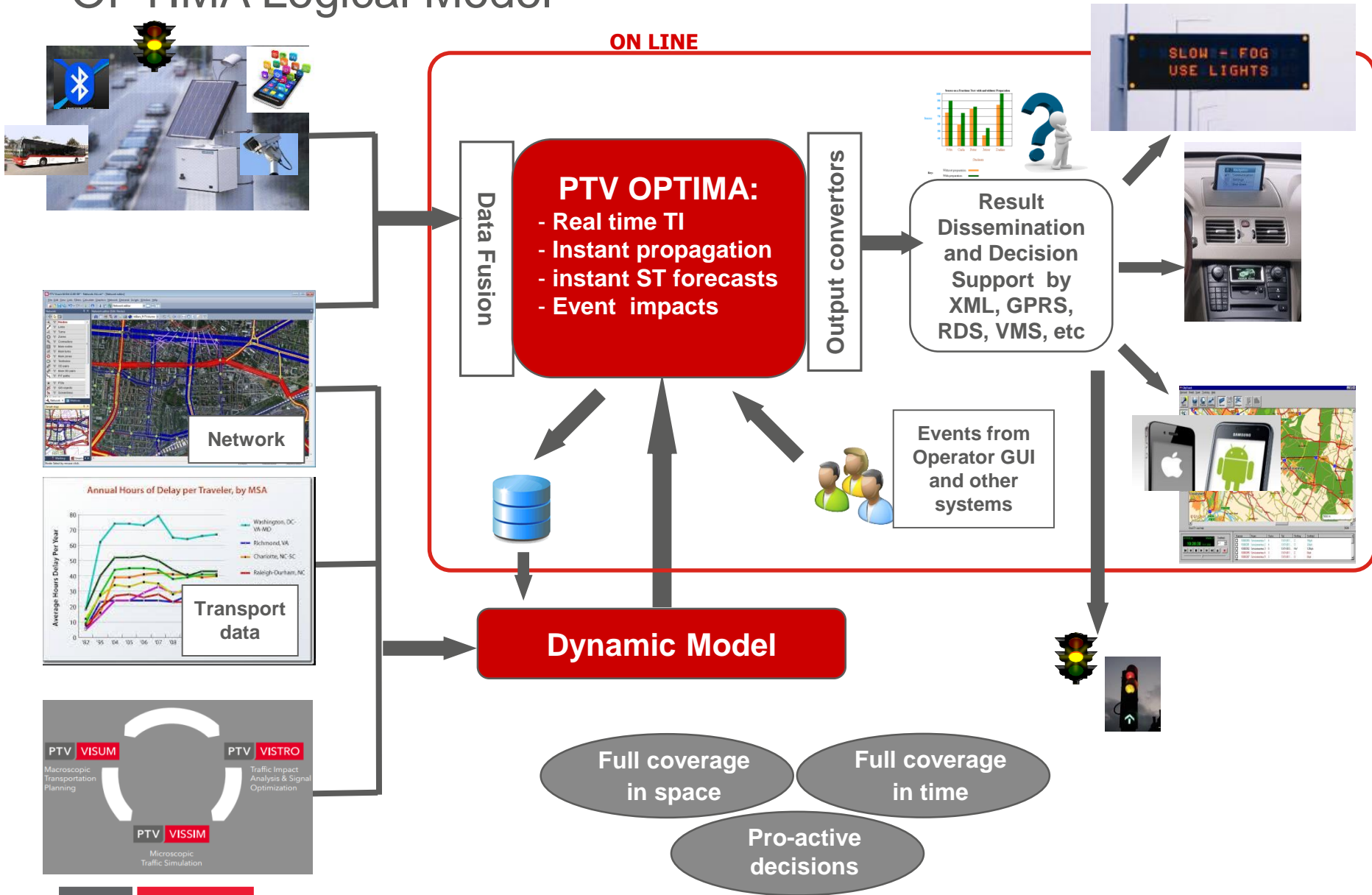


INFORMATION SOURCES AND CONTROL DEVICES

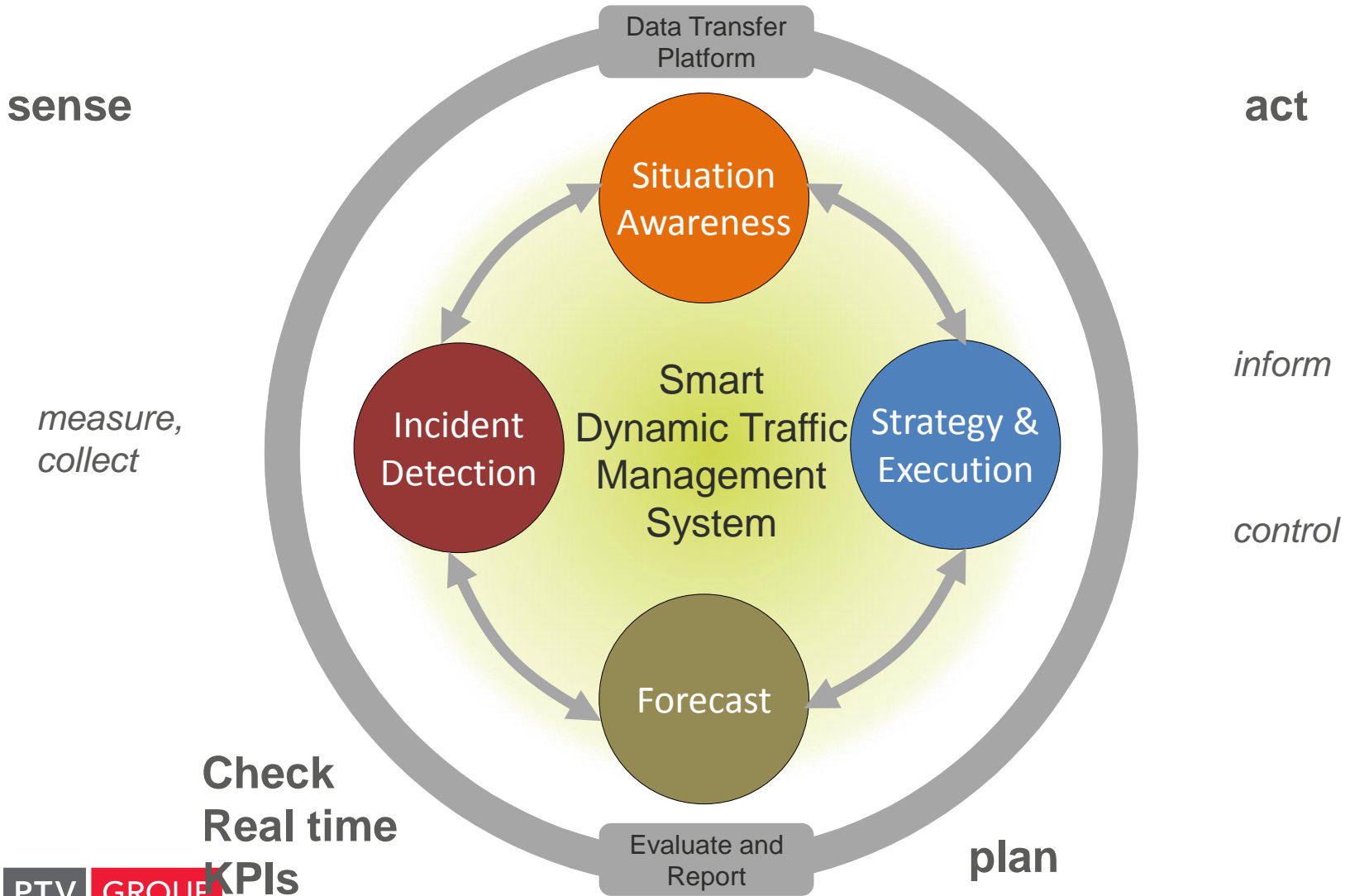


big data

OPTIMA Logical Model

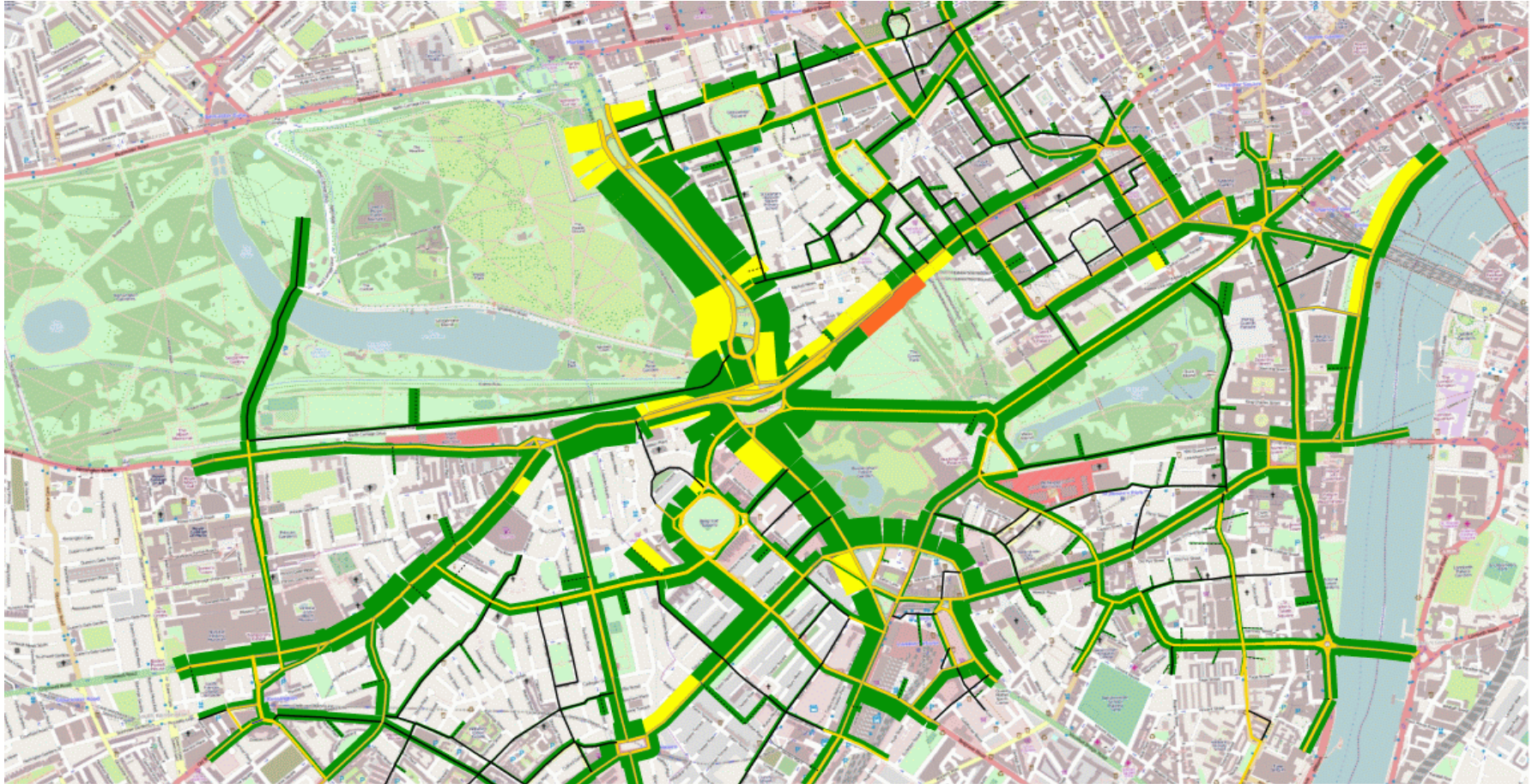


USES DYNAMIC TRAFFIC MANAGEMENT ELEMENTS



<<AUGMENTED>> INFOMOBILITY

... FORECAST FOR 7:30 AM ... SPACE AND TIME EXPANSION



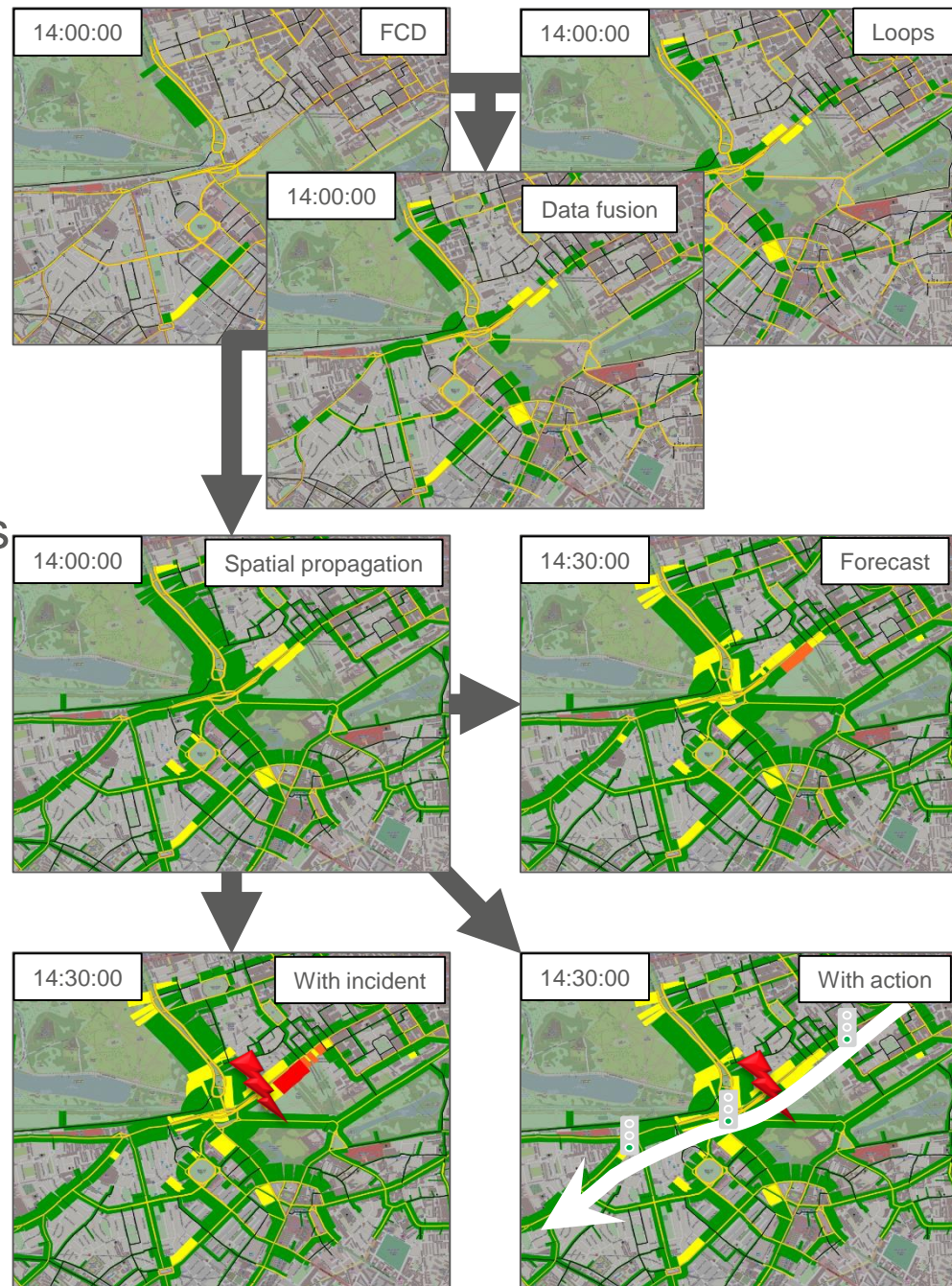
DECISION SUPPORT



SCENARIO SIMULATION
WITHIN 5 MINUTES:
CHANGING SIGNAL PLANS
AND PUBLISHING DIVERSION
ON VMS

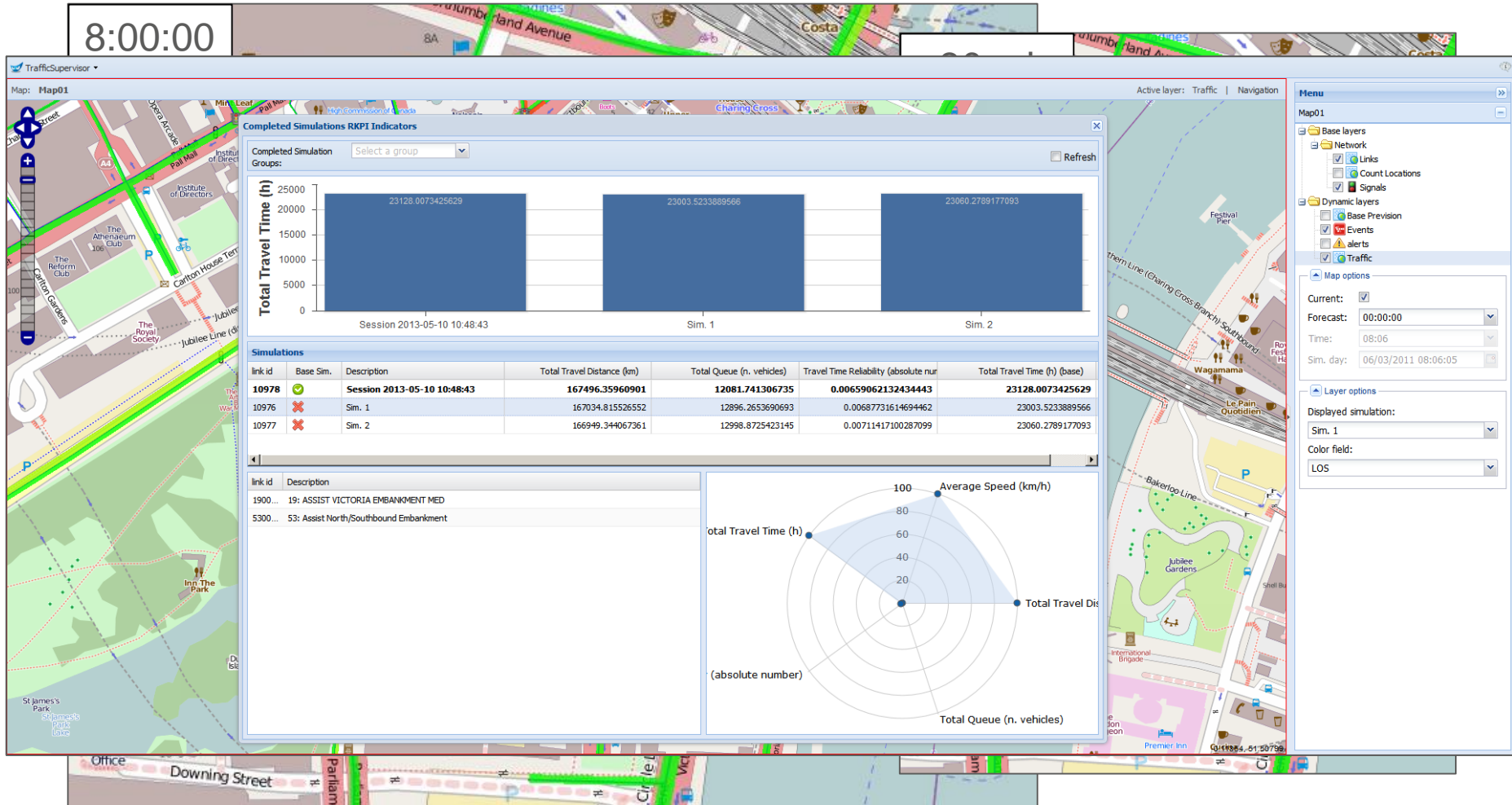
PTV OPTIMA KEY FUNCTIONS

- Traffic data fusion
- Traffic state estimation
- Traffic state forecast
 - under usual conditions
 - with incidents, without actions
 - with incidents, with actions (scenario evaluation and decision support)



PTV OPTIMA - KEY FUNCTIONS DECISION SUPPORT SYSTEM - COMPARISON OF RESULTS

8:00:00



Background image from OpenStreepMap

REAL-TIME



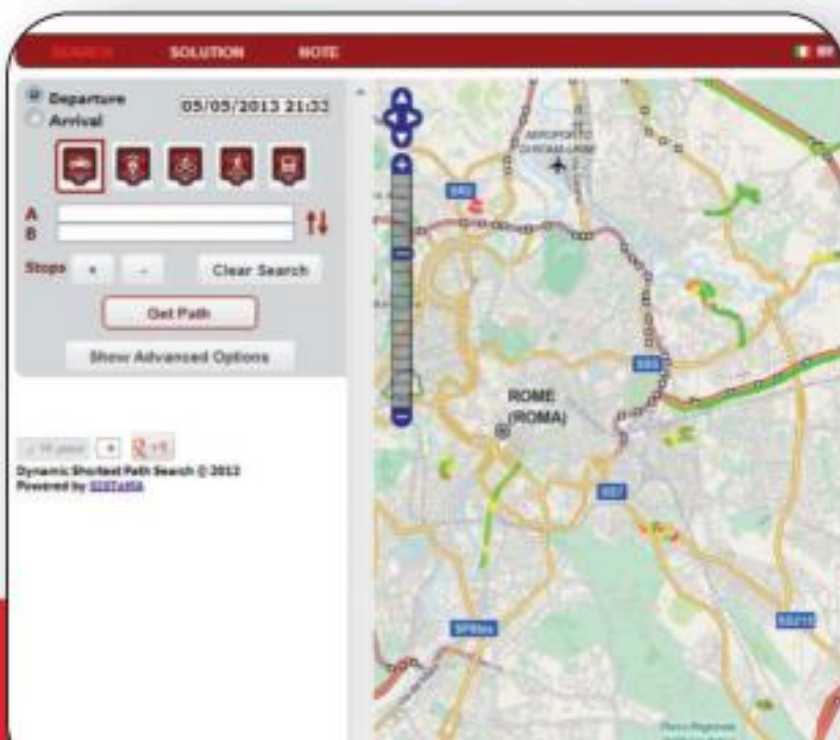
Upgradability from PTV Visum to PTV Optima
Revolutionary real-time traffic management



hyperpath

a new way to find your way

The first journey planner for intermodal dynamic routing taking into account real-time conditions of road networks and transit



Travel on a **multi-modal** transport network by car, bus, subway, bicycle, coach, train, taxi and on foot.

Hop on and off exploiting any feasible interchange, including private-public trips like **park and ride**.

Consider **time dependencies** such as schedule coincidences, service frequencies and limited access zones.

COMPARING APPROACHES FOR TRAFFIC FORECAST

Objective → Method ↓	Traffic Estimation <i>“What is going on?”</i>	Traffic Forecast <i>“What is going to happen?”</i>	Scenario Evaluation & Decision Support <i>“What would happen if?”</i> <i>“What should we do?”</i>
Observed data EASY	Maybe with extensive measures	No	No
Statistical approach ROBUST	YES	"usual" conditions only	No
Simulation Approach EFFECTIVE	YES	YES	YES

LAST OPTIMA REFERENCES

- ❑ **PIEDMONT REGION – Turino (ITALY) : 2011 – 2014**
- ❑ **ERFURT (GERMANY) : 2014**
- ❑ **WIEN (AUSTRIA) : 2014 – 2015**
- ❑ **CATANIA (ITALY) : 2015**
- ❑ **RUSSIAN HIGHWAYS : 2015**
- ❑ **MOSCOW (RUSSIA) : 2014 - 2015**
- ❑ **SACHSEN ANHALT REGION (GERMANY) : 2015 - 2016**
- ❑ **ABU DHABI (UAE): 2015**

➔ **REAL INSTALLATIONS** and not PILOT or small areas

creative talents. As w

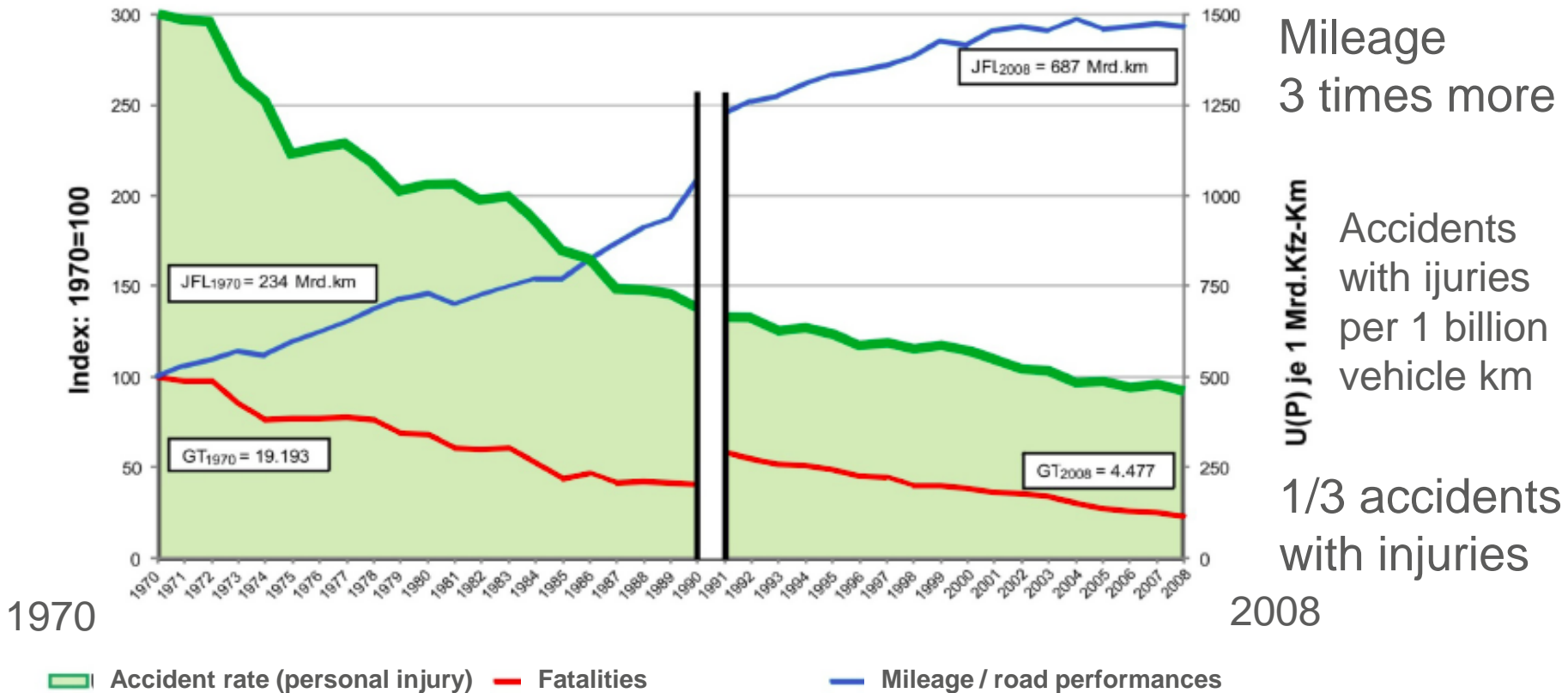
Dubai Community Theatre and



CAN WE SAVE 1 LIFE TODAY?

Road Safety Management and Prediction tool
for highways

HOW TO IMPROVE ROAD SAFETY? ACCIDENT HISTORY AND MILEAGE IN GERMANY



Mileage
3 times more

Accidents with injuries
per 1 billion
vehicle km

1/3 accidents
with injuries

Source: 2009 ADAC Fachveranstaltung, Sichere Straßen retten Leben

Road safety in Germany - a success story over the last 40 years!

CRASH PREDICTION

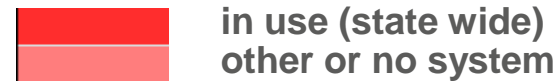


**Tomorrow at 11:34 a
crash will happen here.**

ACCIDENT DATA ANALYSIS OF POLICE IN GERMANY – A SOLID NATIONAL BASE



PTV EUSKA accident database



- > Police authorities of **11 federal states** generates accurate accident data
- > Cover **70%** of all police recorded accidents in Germany
- > About **1000 users**
- > more than **10 years** experience with applications at police authorities

DATA VALIDATION BASED ON PTV VISTAD

AF22-07.JPG

VERKEHRSUNFALLANZEIGE

Blatt 1

Characteristics of crash location

Dienststelle	An Bußgeldbehörde/Staatsanwaltschaft	Eingangsstempel	Tatbestandsaufnahme <input type="checkbox"/>
Tab.Nr.:	Ordnungswidrigkeit	RS	Kra
Unfallort (Tag/Monat/Jahr)	Unfallort (Jahr)	Schwerwiegend	Leichtwiegend
Charakteristika der Unfallstelle	SA2	Innenort	außenort
Einrichtung	Grundrissplan oder Aufsicht	Erhebung	Geräte
Spezialcharakteristika der Unfallstelle	Schienenübergang	Fußgängerüberweg (Zebrastreifen)	Fußgängerfurt
Lichtzeichenanlage	In Betrieb	außer Betrieb	
Geschwindigkeitsbegrenzung	(durch Z27/Z27.1 angeordnet - km/h)		
Straßenzustand	Trocken	Nass/feucht	Winterschlamm
Aufprall auf Hindernis neben der Fahrbahn	Baum	Mast	Widerlager

Crash list 1966955/2011

Crash

- Crash data
 - Overview
 - History
 - Location
 - Other crash data**
- Involved person 1
 - Person
- Involved person 2
 - Person
 - Vehicle

Other crash data

Crash location

Characteristics of the crash location

- 1 - Intersection
- 0 - No special characteristics
- 1 - Intersection**
- 2 - T junction
- 3 - Driveway
- 4 - Slope (ascending)
- 5 - Slope (descending)
- 6 - Curve

Characteristics of the crash site

Other characteristics

Traffic control signal

Speed limit

Characteristics of crash location

- Verkehrsunfallanzeige, Bl. 1 - Aufw. f. estadische Aufbereitung - Ausgeschwärmte Felder werden statistisch nicht erfaßt.

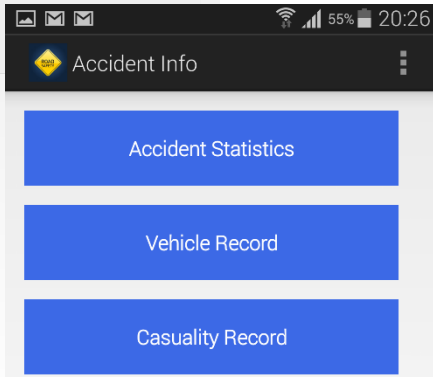
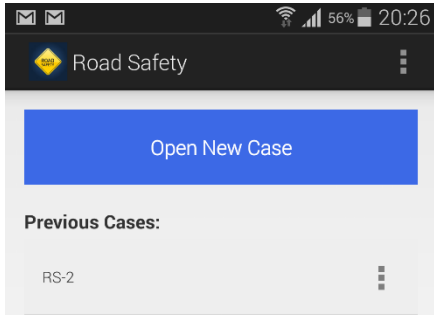
Accident report – registration of statistically accident data

Data content for the accident investigation:

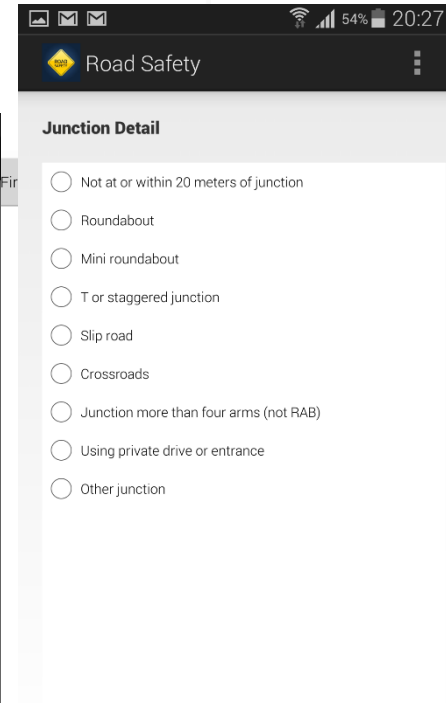
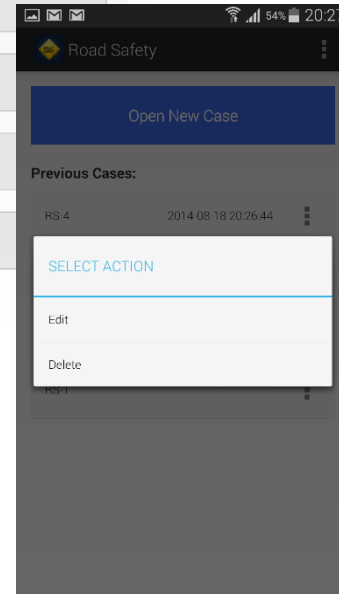
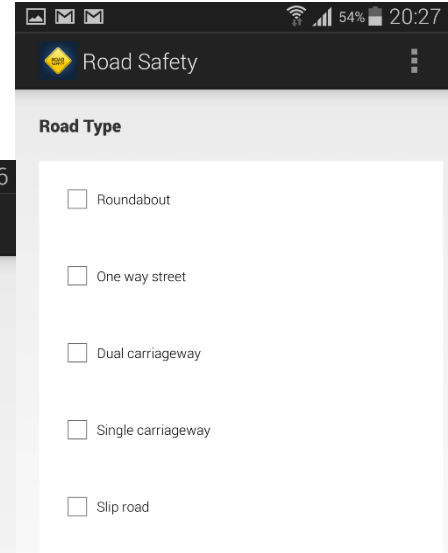
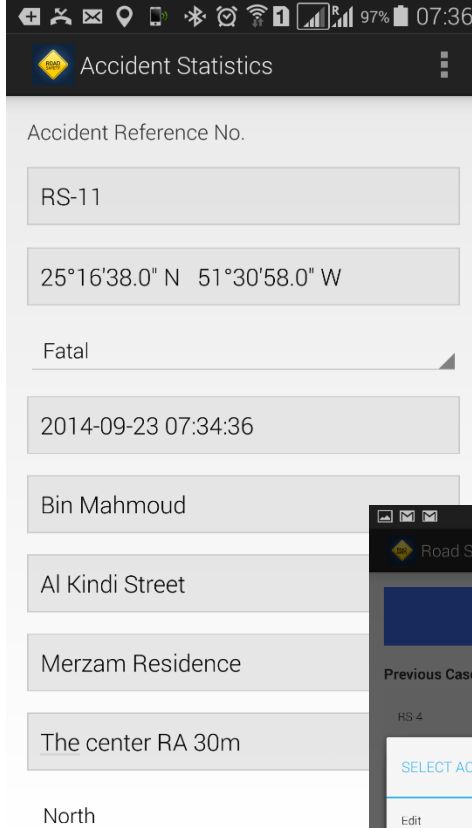
- classification
- data regarding the site
- description of the accident
- personal data, vehicle data

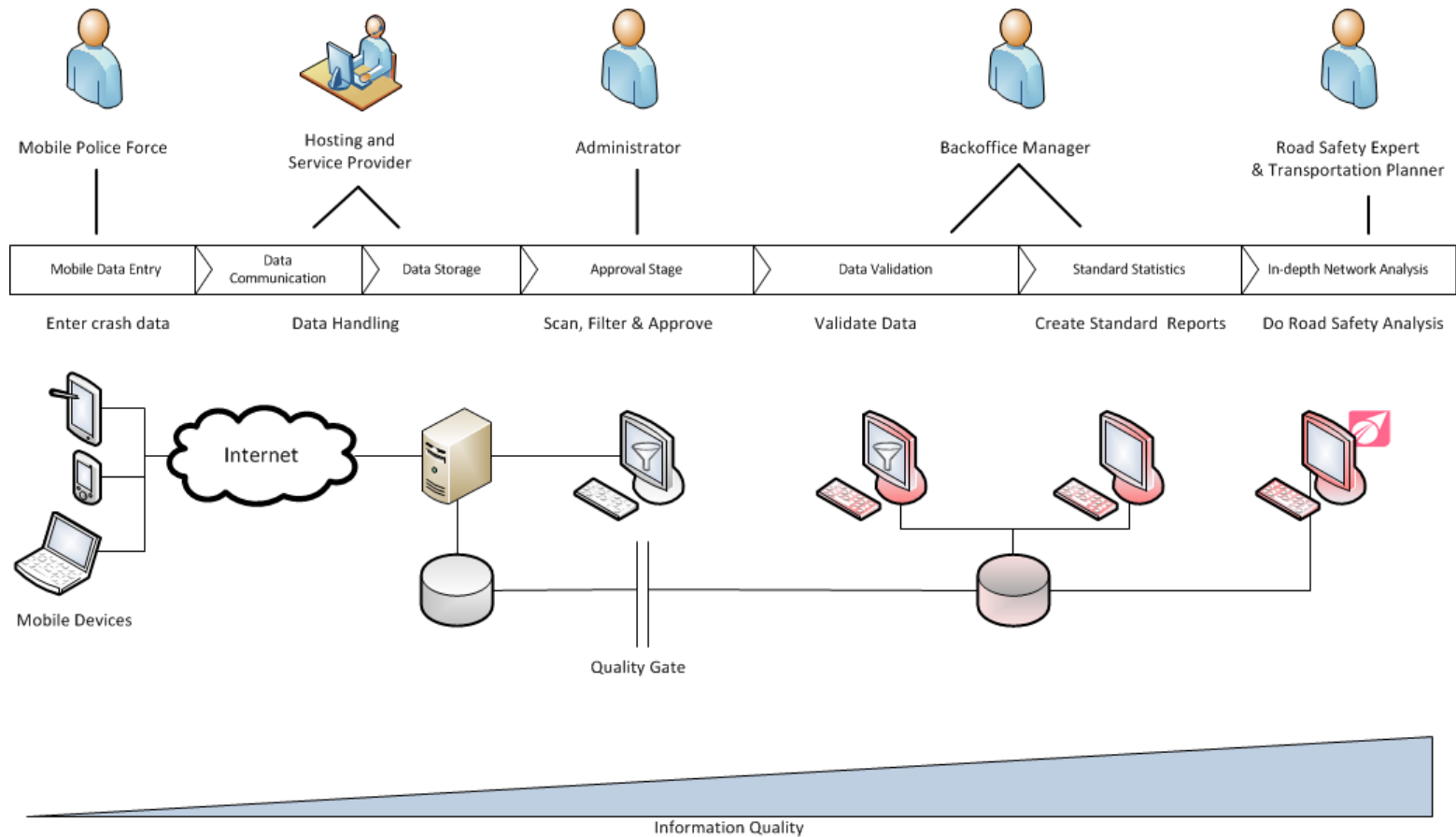


Clash Data Collection Mobile Application for IOS and Android










ANDROID





Collision Types

- 1  **Driving accident**
- 2  **Turning accident**
- 3  **Entering / crossing accident**
- 4  **Crossing over accident (Pedestrian)**
- 5  **Accident caused by stopping / parking**
- 6  **Accident in longitudinal traffic**
- 7  **Other accident**

SEVERITY OF ACCIDENTS

 **Fatality / killed persons**
(8 mm circle and 10 mm square)

 **Serious injury accident**
(8 mm circle)

 **Slight injury accident**
(4 mm circle)

ROAD SAFETY MANAGEMENT WITH PTV SOLUTIONS

The image displays two overlapping screenshots of the PTV Vistad 7.0 software interface. The primary screenshot shows the 'Overview' section for a crash event on 12/31/2011. The 'Crash data' section includes:

- Classification: 1 - Road accident
- Category: 2 - Accident with serious injuries
- Crash type: 3 - Turning-into / crossing
- Type of Collision: 5 - Collision with turning or crossing vehicle
- Involved: 2 ; other damaged parties: 0
- Fatalities: 0
- Severely injured: 0
- Slightly injured: 1
- Total property damage: 2.250 €
- Other property damage: [input field]
- Internal notes: [input field]
- Checkboxes: Alcohol, Drugs, Hazardous goods, Hit and run, Motor vehicle not roadworthy, Hit and run - solved

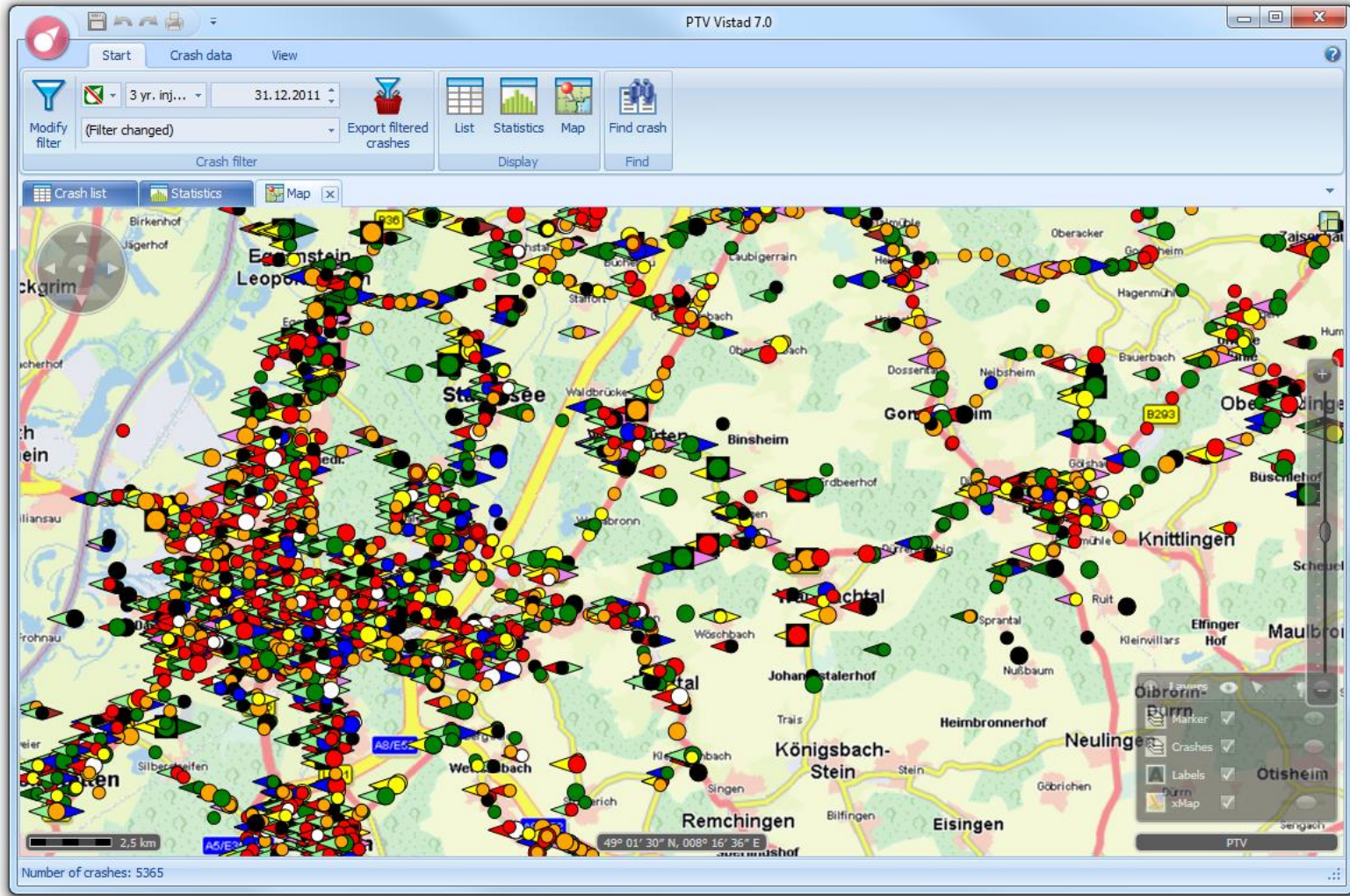
The 'Course of events' section contains the following text:

Participant 01 drove along A-Road and stopped at sign 206. Afterwards 01 entered the intersection, crossed B-Road and 01 overlooked 02 a motor cyclist from the right sight. 01 hit 02. 02 wore a helmet but had to be taken to the hospital (rb fracture), both vehicles had property damage.

The secondary screenshot shows a map view with a table of 'Points of interest 61: Black Spots':

Count	Name	Accident count
1	BS 1	8
2	BS 2	8
3	BS 3	7
4	BS 4	7
5	BS 5	6
6	BS 6	6
7	BS 7	6
8	BS 8	6
9	BS 8	6
10	BS 9	5
11	BS 10	5
12	BS 11	5

ACCIDENT MAPPING AND FILTERING



PTV VISTAD DATA FILTERING

The screenshot displays the PTV Vistad 7.0 software interface. At the top, there is a menu bar with 'Start', 'Crash data', and 'View'. Below the menu bar is a toolbar with various icons for filtering and data manipulation. The main window is divided into several sections:

- Crash filter:** A section on the left with a 'Modify filter' button and a dropdown menu showing '(Filter changed)'. It also includes an 'Export filtered crashes' button.
- Display:** A section with buttons for 'List', 'Statistics', 'Map', and 'Find crash'.
- Crash filter panel:** A panel showing the number of crashes (896) and a tree view of filter categories on the left. The right side of this panel shows the active filter rules:
 - [Crash date] Is between 01.01.2010 and 31.12.2010
 - [Department] Equals KA
 - [Category] Is any of (1 - Fatal accident, 2 - Accident with serious injuries, 3 - Accident with light injuries)
 - [Crash type] Is any of (2 - Turning-off, 3 - Turning-into / crossing)
- Crash list:** A table at the bottom showing a list of crashes with columns for Crash ID, Date, Time, Cat., Police station, Town, Road, and Parish. The table is filtered to show only crashes from January 2010.

Number of crashes: 896

Crash ID	Date	Time	Cat.	Police station	Town	Road	Parish
0003751/2010	01.01.2010	16:00	3	KA	Oberhausen-Rheinhausen	B 36	215107
0014565/2010	04.01.2010	15:00	3	KA	Karlsruhe	Erbprinzenstraße	212000
0025358/2010	06.01.2010	17:00	3	KA	Oberhausen-Rheinhausen	Kolpingstraße	215107
0029512/2010	07.01.2010	11:00	3	KA	Bruchsal	Am See	215009
0035792/2010	07.01.2010	11:00	3	KA	Oberderdingen	Flehinger Straße	215059
0029127/2010	07.01.2010	14:00	3	KA	Ettingen	B 3	215017
0031517/2010	07.01.2010	17:00	3	KA	Karlsruhe	Reinhold-Frank-Straße	212000
0034571/2010	08.01.2010	13:00	2	KA	Karlsruhe	Hoffstraße	212000
0035553/2010	08.01.2010	16:00	3	KA	Karlsruhe	Markgrafenstraße	212000

Number of crashes: 896

VARIOUS STATISTICS AND REPORTING CAPABILITIES

Accident data

Statistics

Total number of accidents: 10594
Total accident cost: 180549 k€

Number of fatalities: 12
Number of serious injuries: 651
Number of light injuries: 3903

Accident severity

	Count	Cost
Serious injuries	622 (6%)	96555 k€ (53%)
Light injuries	3005 (28%)	37237 k€ (21%)
Property damage only	6967 (66%)	46758 k€ (26%)

Accident types

Involved road users

Contributing environmental factors

Contributing individual factors

	Count	Cost
Tree	51 (0%)	1672 k€ (1%)
Obstacle off Road	916 (9%)	25158 k€ (14%)
Overtaking	268 (3%)	5425 k€ (3%)
Alcohol	478 (5%)	15483 k€ (9%)
Speeding	725 (7%)	25176 k€ (14%)
Red Light offence	383 (4%)	9706 k€ (5%)

Auswertung der Verkehrsunfalldaten

Beschreibung des Berichts:
Unfallauswertung Dresden 2004-2008

2004 - 2008

VU in Monaten

Monat	Count
Jan	363
Feb	335
Mar	717
Apr	901
May	1.080
Jun	1.190
Jul	1.011
Aug	992
Sep	1.014
Ok	1.010
Nov	873
Dec	382

VU an Tagen

Wochentag	Count
Samstag	1.733
Freitag	1.740
Donnerstag	1.689
Mittwoch	1.822
Dienstag	1.800
Freitag	1.160
Samstag	818

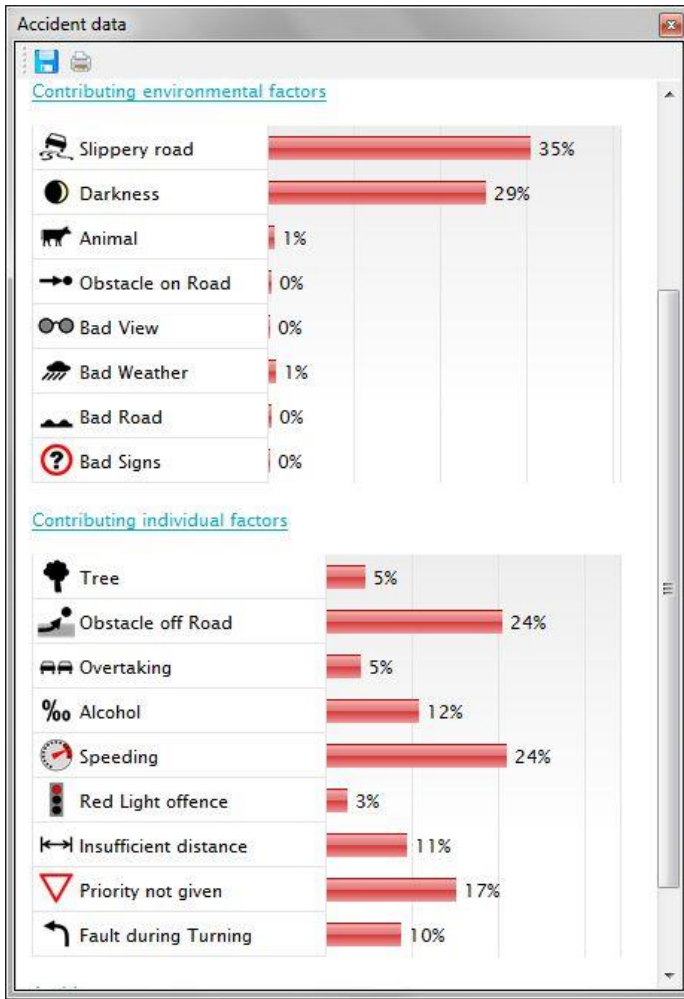
VU im Tagesverlauf

Zeit	Count
0	27
1	48
2	58
3	62
4	65
5	68
6	70
7	72
8	75
9	78
10	80
11	82
12	85
13	88
14	90
15	92
16	95
17	98
18	100
19	102
20	105
21	108
22	110
23	112
24	115
25	118
26	120
27	122
28	125
29	128
30	130
31	132

Date	Time	Severity	Cost	Accident Type	Contributing Factors	Other
2011-03-18	9:00	7	*	6		
2010-12-07	19:00	7	*	6		
2010-01-15	18:00	6	315			
2009-09-10	17:00	6	18			
2009-10-07	9:00	6	18			
2010-01-17	21:00	6	6			
2011-03-31	16:00	6	6			
2009-08-03	7:00	5	255			
2010-06-22	17:00	5	255			
2011-09-04	23:00	5	255			
2010-01-07	14:00	5	18			
2010-03-19	21:00	5	18			
2010-03-26	20:00	5	18			
2011-03-28	22:00	5	18			
2010-04-16	15:00	5	18			
2010-01-15	22:00	5	13			
2010-01-16	7:00	5	13			
2010-03-07	18:00	5	13			
2010-05-24	19:00	5	6			
2011-09-05	7:00	5	13			
2011-11-11	18:00	5	13			
2023619/2011	2011-11-20	5	13			
2178204/2010	2010-12-20	5	6			
2257045/2011	2011-12-29	5	13			
1628418/2009	2009-11-07	2	18,5			
0082892/2010	2010-01-17	2	13			
0112098/2010	2010-01-21	2	13			
1863955/2010	2010-10-28	2	13			
1976532/2010	2010-11-16	2	13			
1549219/2011	2011-09-04	1	17,5			

Showing 1 to 30 of 30 entries

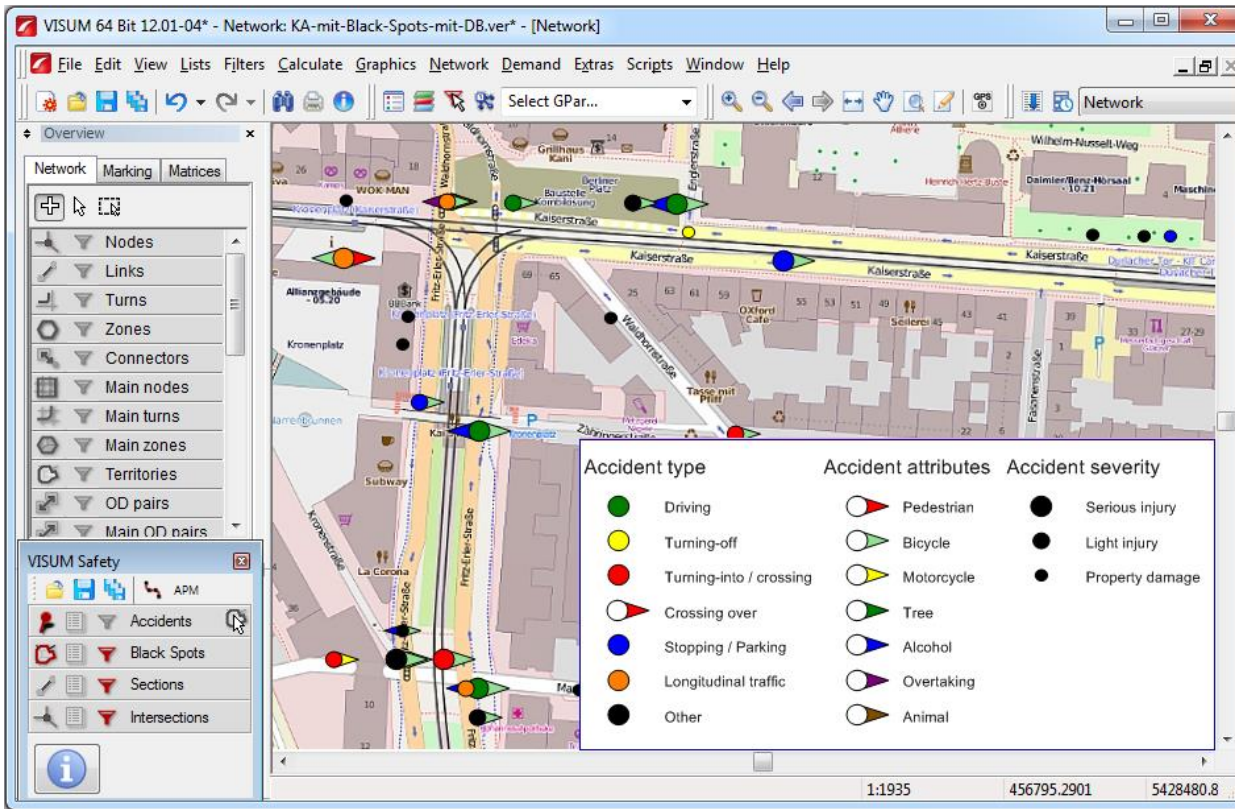
BLACK SPOT MANAGEMENT ON MICRO LEVEL – Some statistics on accident data with PTV Visum Safety



PTV Visum Safety supported some statistics based on accident attributes to give first indicators about road safety for instance:
Slippery roads 35% (30%)
Darkness 29% (30%)
 (Expected values in Germany cities)

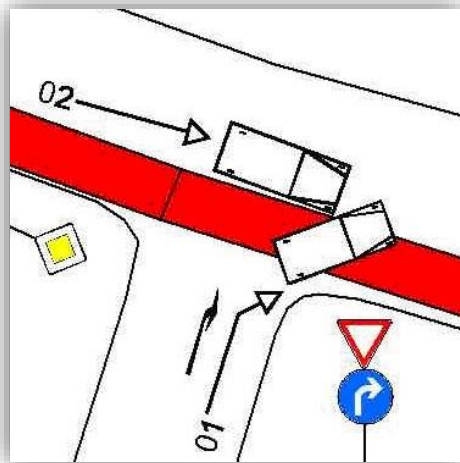
Ausprägung	der Unfallumstände (Durchschnittswerte Deutschland)*			
	innerorts	Landstraße	BAB	
Winter	30%	35%	35%	Dez - März
Wochenende	25%	30%	30%	Sa / So
Spitzenzeiten	45%	45%	45%	6 - 9 / 16 - 19
Nacht	30%	35%	40%	dä / du
Nässe / Glätte	30%	40%	45%	na / wgl

ACCIDENT MAPPING IN DETAIL



The accident data are systematically displayed in a pragmatic and intuitive format based on more than 30 years experience with police officers in Germany. PTV Visum Safety displays accidents types (conflict situation).

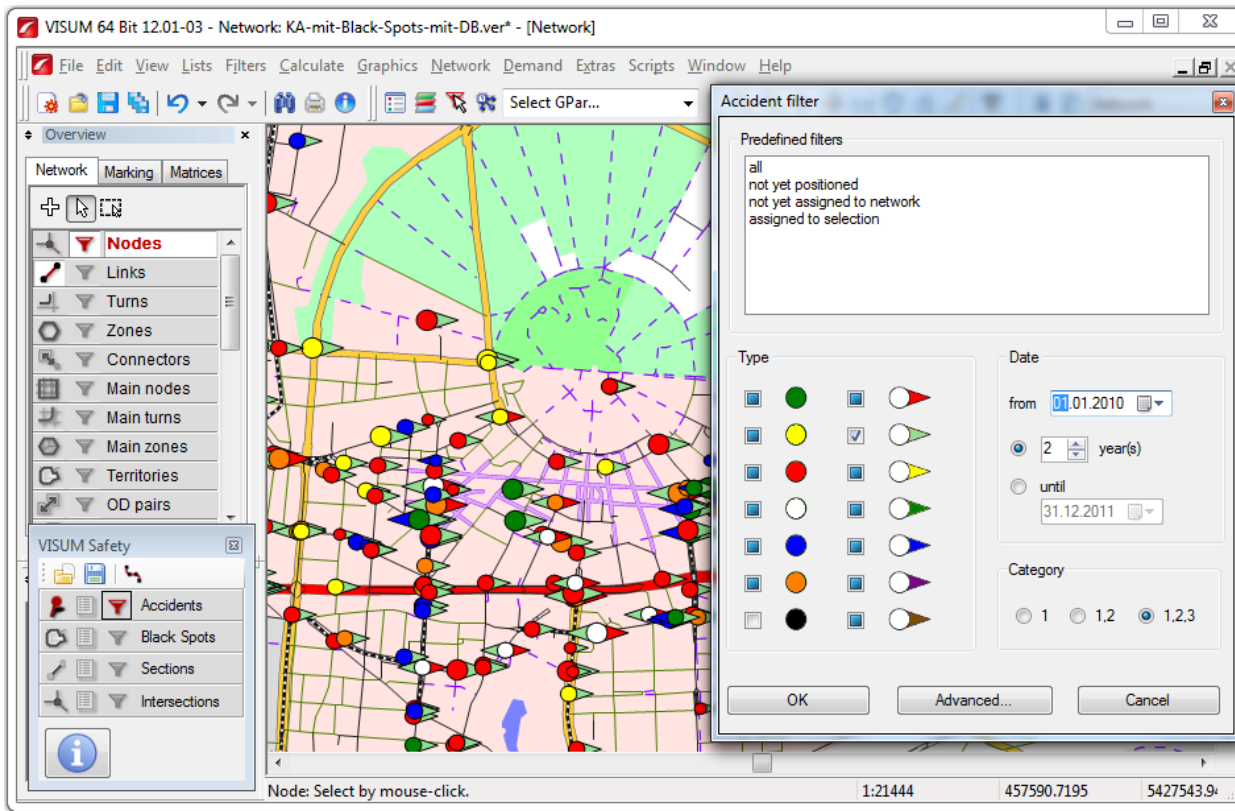
MITIGATE MEASURE TO ELIMINATE BLACK SPOTS



Crash data application overview

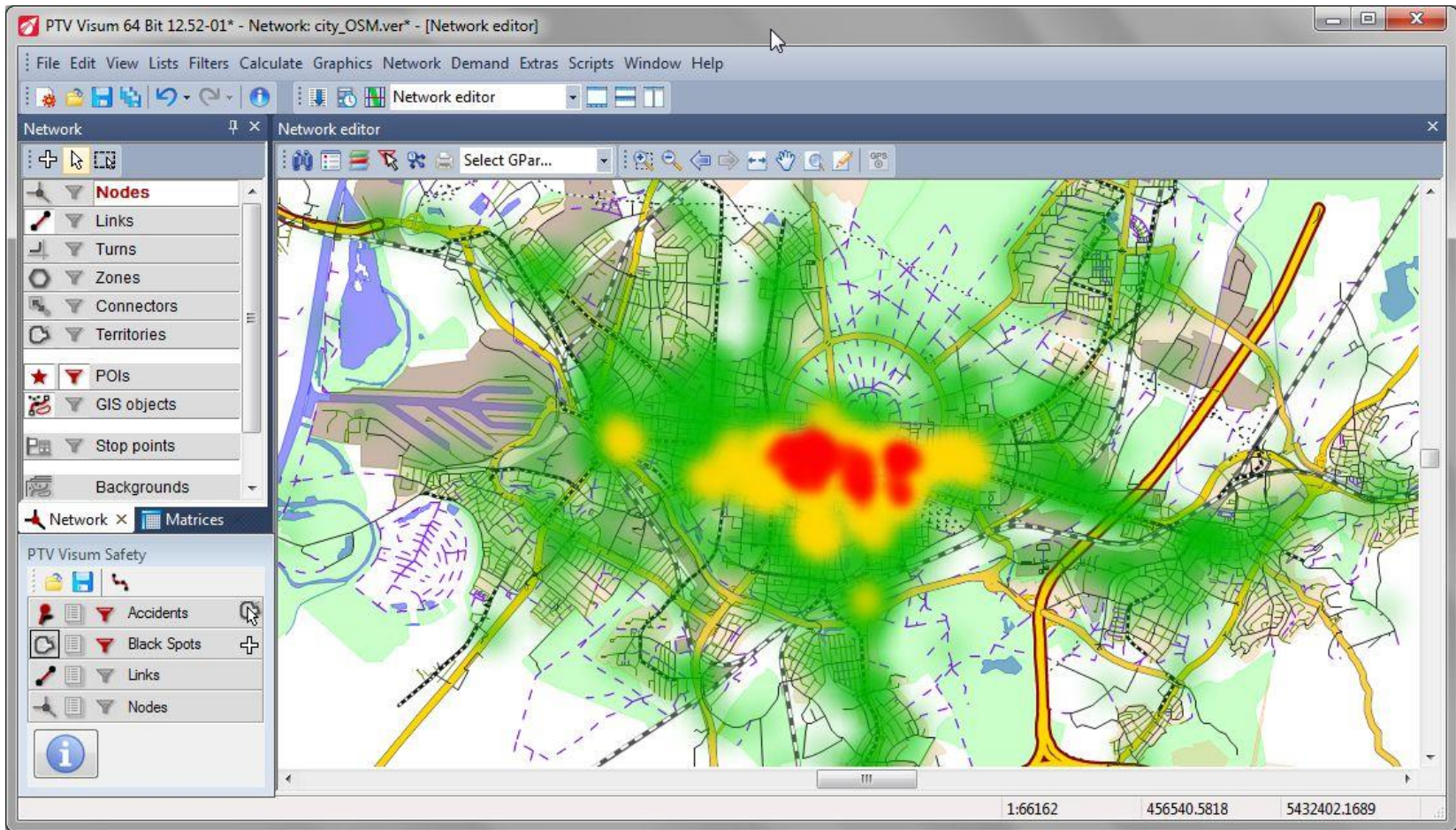
- Crash data management
- Black spot analysis
- Find mitigate measure to eliminate black spots

EASY FILTERING ACCIDENT DATA – ACCIDENTS WITH CYCLISTS



The accident data can be filtered depending on the accident main attributes. Easy filtering of accidents with cyclists.

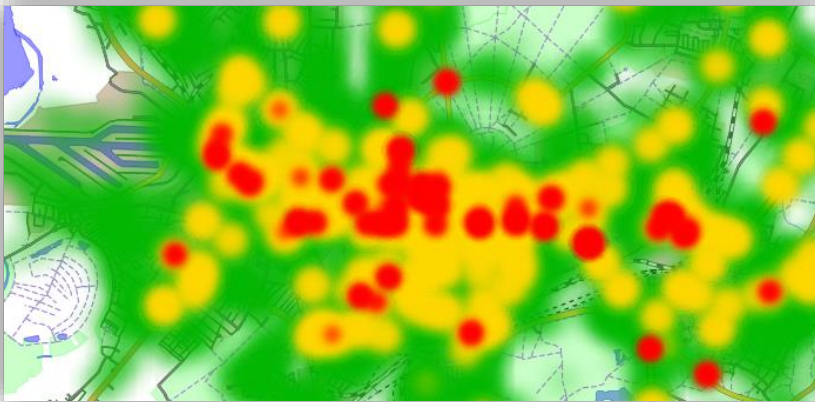
HEAT MAP OF THE CITY AREA



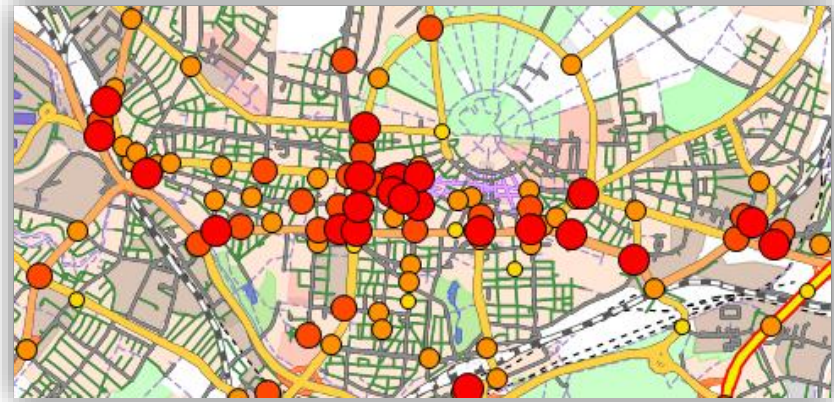
PTV Visum Safety generates a heat map based on user accident data to focus road safety action programs on the significant areas e.g. cyclists.

ACCIDENT DATA ANALYSIS

➤ Heat map



➤ Find black spots



➤ View accident attributes

			9	4	6	2	6	8
④	●	385	●	●				
③	●	255						●
③	●	255	●	●		●		●
③	●	255			●			●
③	●	18	●					●
③	●	18						●
①	●	17.5	●		●		●	
①	●	17.5	●		●		●	
⑥	●	18						●
①	●	17.5	●				●	

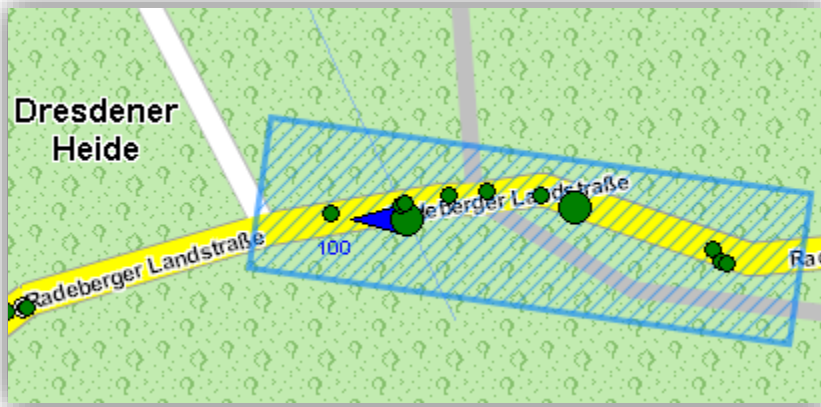
➤ Attribute distribution

Accident types

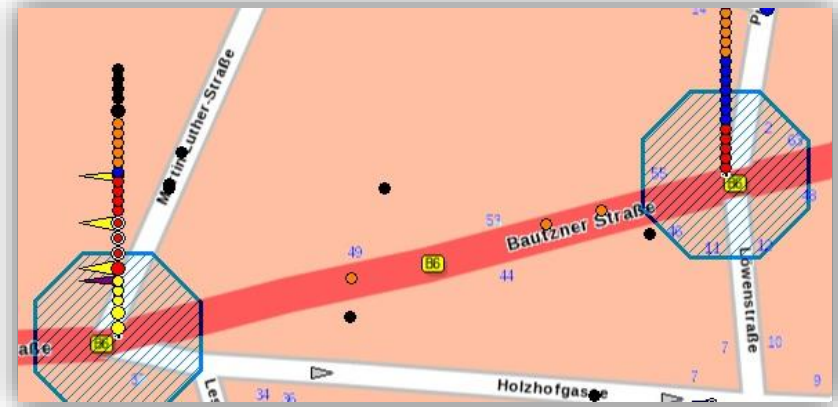
	Count	
① Driving	289	13%
② Turning-off	441	20%
③ Turning-into / crossing	676	30%
④ Crossing over	250	11%
⑥ Longitudinal traffic	590	26%

BLACK SPOT ANALYSIS

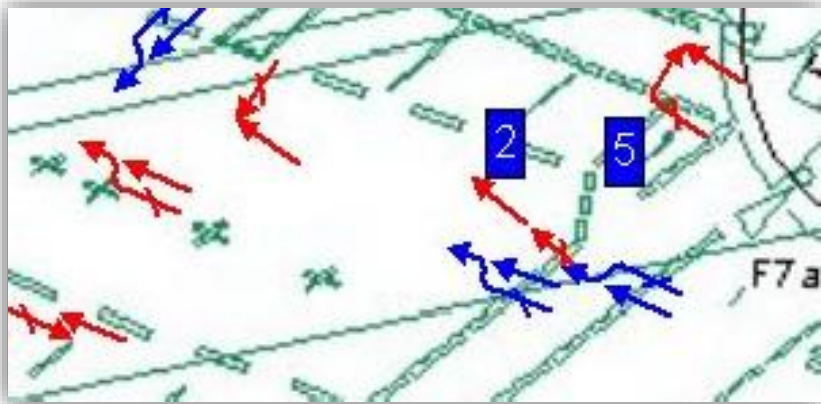
➤ Define black spots



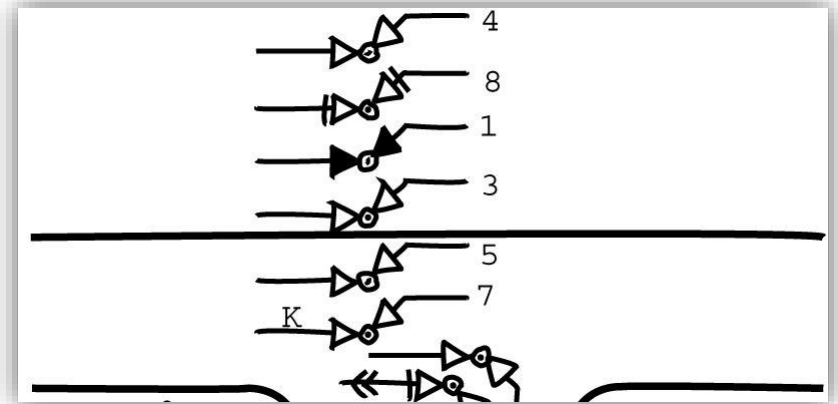
➤ Compare black spots



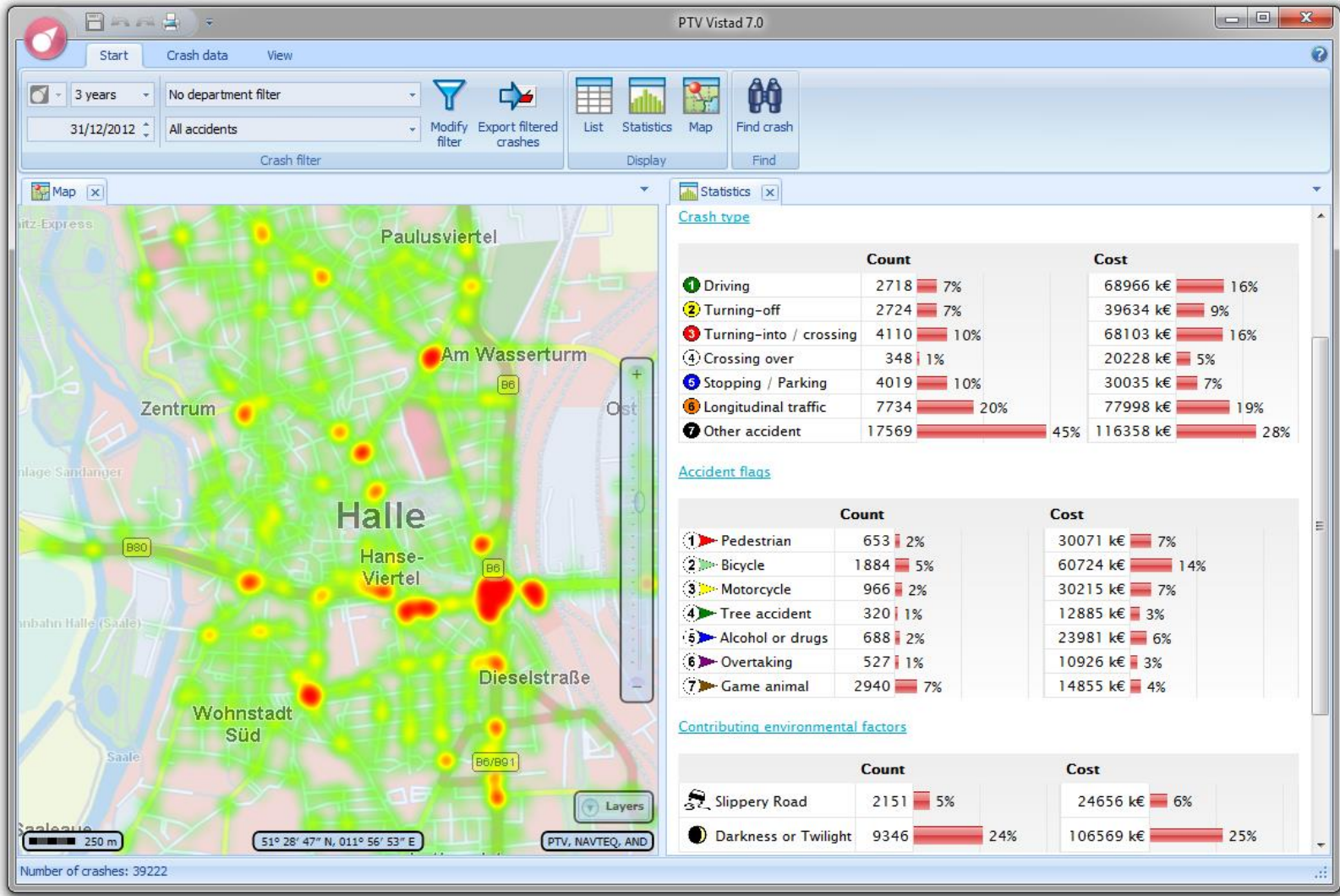
➤ Find similarities



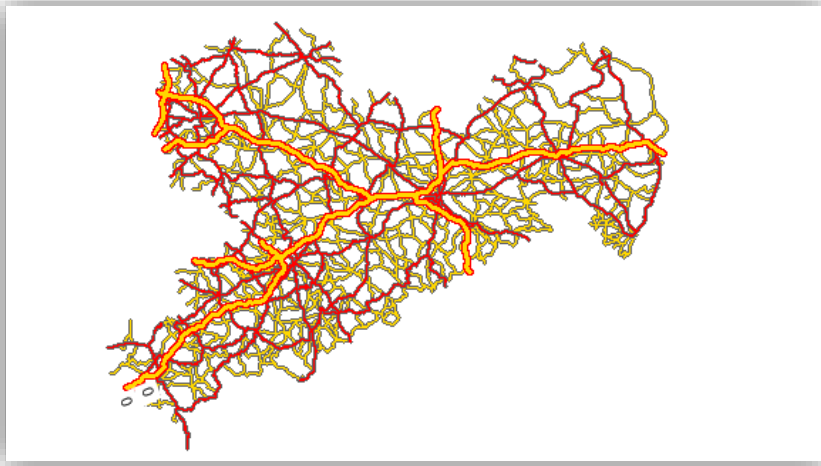
➤ Draw a conflict diagram



EXAMPLE OF AN CRASH DATABASE APPLICATION



ROAD SAFETY ANALYSIS COMBINED WITH ROAD NETWORK



Use road network linkage on applications for

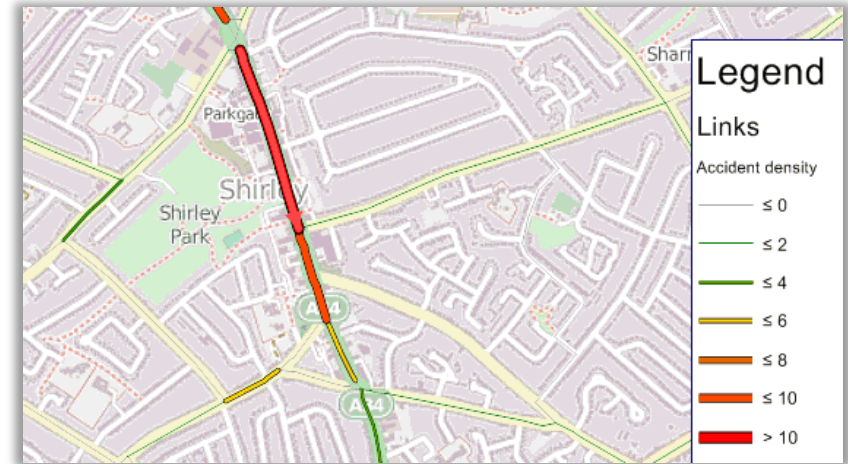
- Crash data & black spot analysis
- Network safety management
- Crash prediction models

NETWORK SAFETY MANAGEMENT



Allocation of accidents

- All accidents are allocated to a road or an intersection
- Allocation can be done manually or automatically



Calculation of safety indicators

- 19 Accidents in 3 years on a 600m road with 1650 veh/day:
- Density: 10.5 Accidents per year per km
 - Rate: 17.5 Accidents per million vehicle kilometers

ACCIDENT ALLOCATION

Automatic allocation

max. distance link
20

max. distance node
20

Allocate to link or node?

node first if possible

match accident attribute 'intersection'

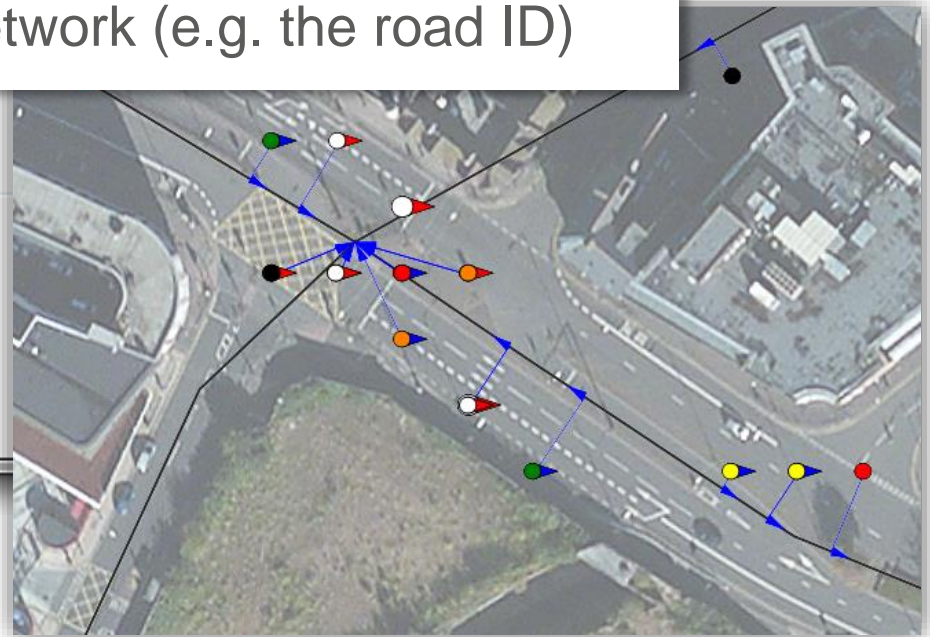
match link attribute Road Type

match link attribute Road Id

OK

Allocate many accidents at once

- Set a maximum distance to the network
- Optionally force matching attributes of the accidents and the network (e.g. the road ID)



NETWORK SAFETY MANAGEMENT

THE BENEFIT OF THE ROAD NETWORK LINKAGE

► Road Network as a filter



► Dangerous intersections



► Density: crashes/km

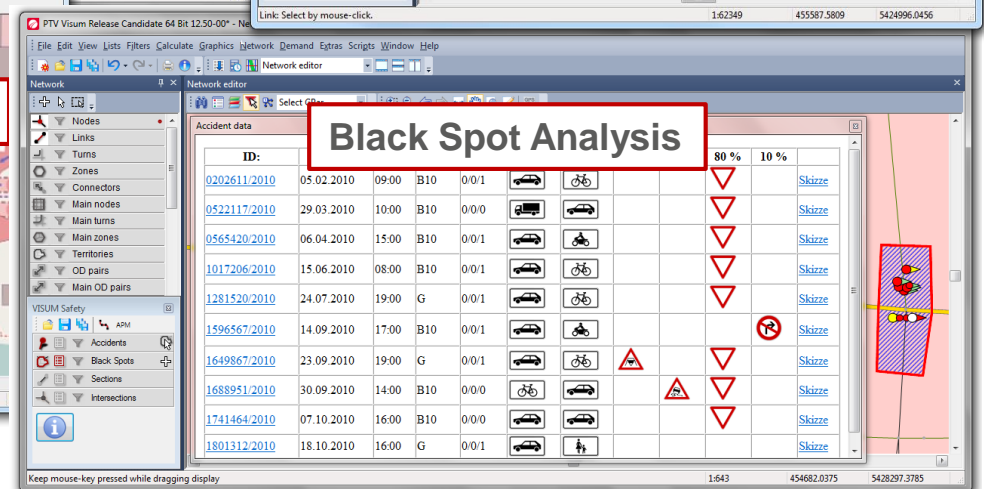
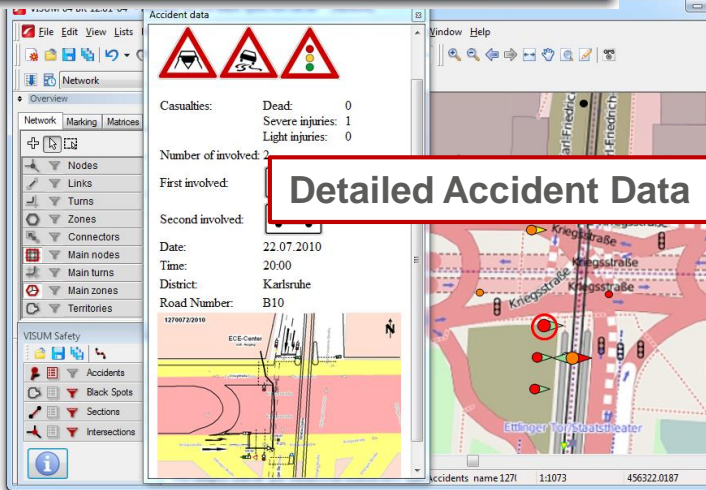
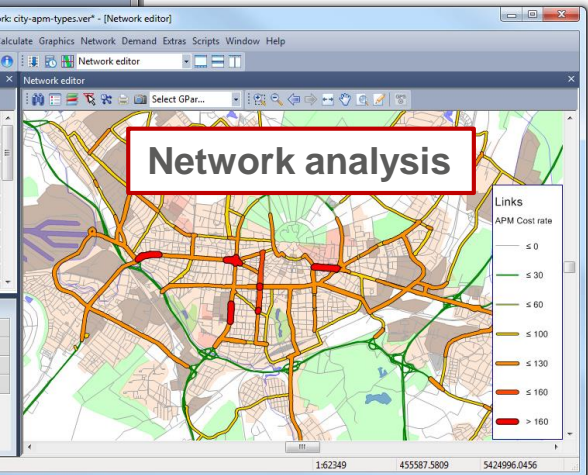
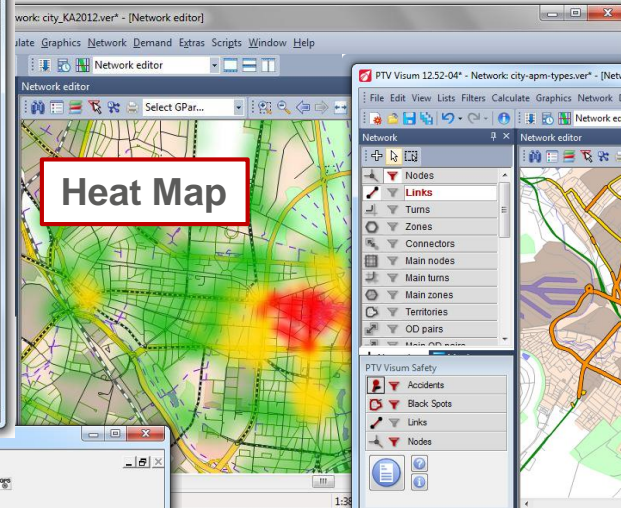
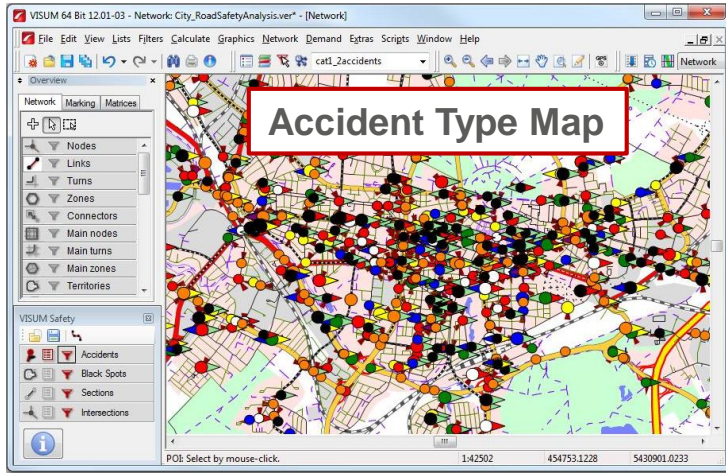


► Rate: crashes /Veh·km



Background maps: © OpenStreetMap contributors

BLACK SPOT MANAGEMENT BASED ON PTV VISUM SAFETY



ROAD ONE SAFETY APPLICATION COVERS ALL LEVELS

RURAL

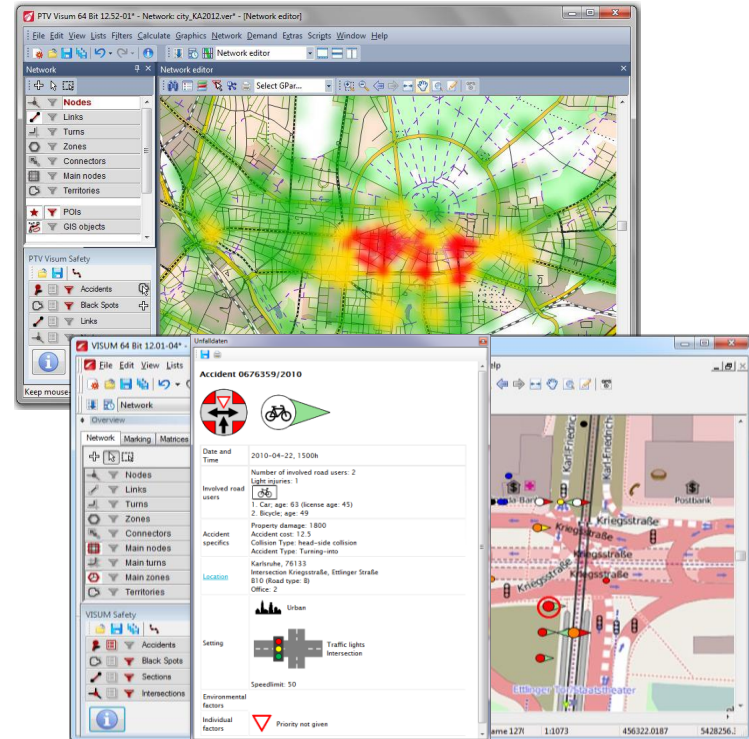
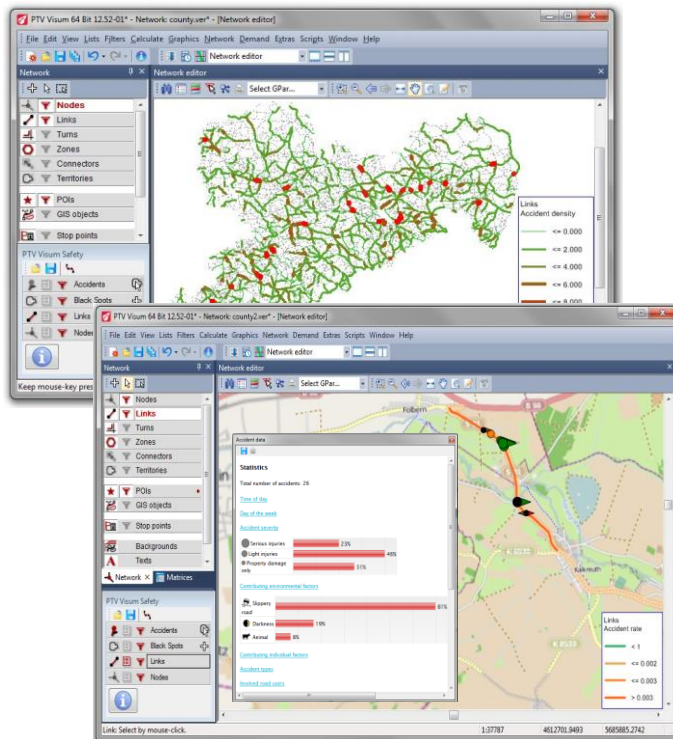
URBAN

MACROSCOPIC

MICROSCOPIC


























































NSM

BSM



Data table

Search:

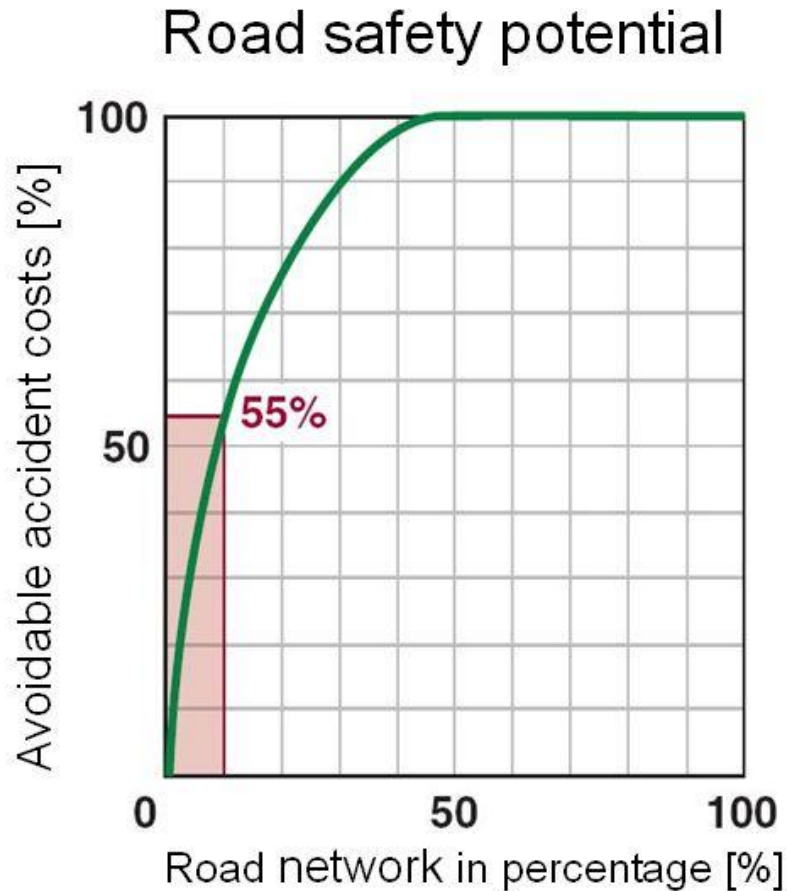
Accident ID	Date	Time											
0936938/2011	2011-05-30	17:00	2			135							
0356524/2013	2013-03-03	17:00	2			41.5							
1015647/2011	2011-06-11	13:00	2			13							
1098016/2011	2011-06-25	15:00	2			13							
1348401/2012	2012-08-03	14:00	2			41.5							
1869372/2011	2011-10-26	6:00	2			12.5							
1462421/2012	2012-08-22	22:00	2			41.5							
0548669/2011	2011-04-01	19:00	2			13							
0731434/2012	2012-05-01	15:00	2			41.5							
1332051/2013	2013-08-02	17:00	2			41.5							
1564782/2011	2011-09-06	18:00	2			12.5							
2244247/2011	2011-12-27	17:00	2			12.5							

Showing 1 to 12 of 12 entries



12 crashes with injuries in 3 years
 3 severity injured
 9 slightly injured

NETWORK SAFETY MANAGEMENT: WHAT DOES SAFETY POTENTIAL TELL ME ABOUT MY ROAD NETWORK?



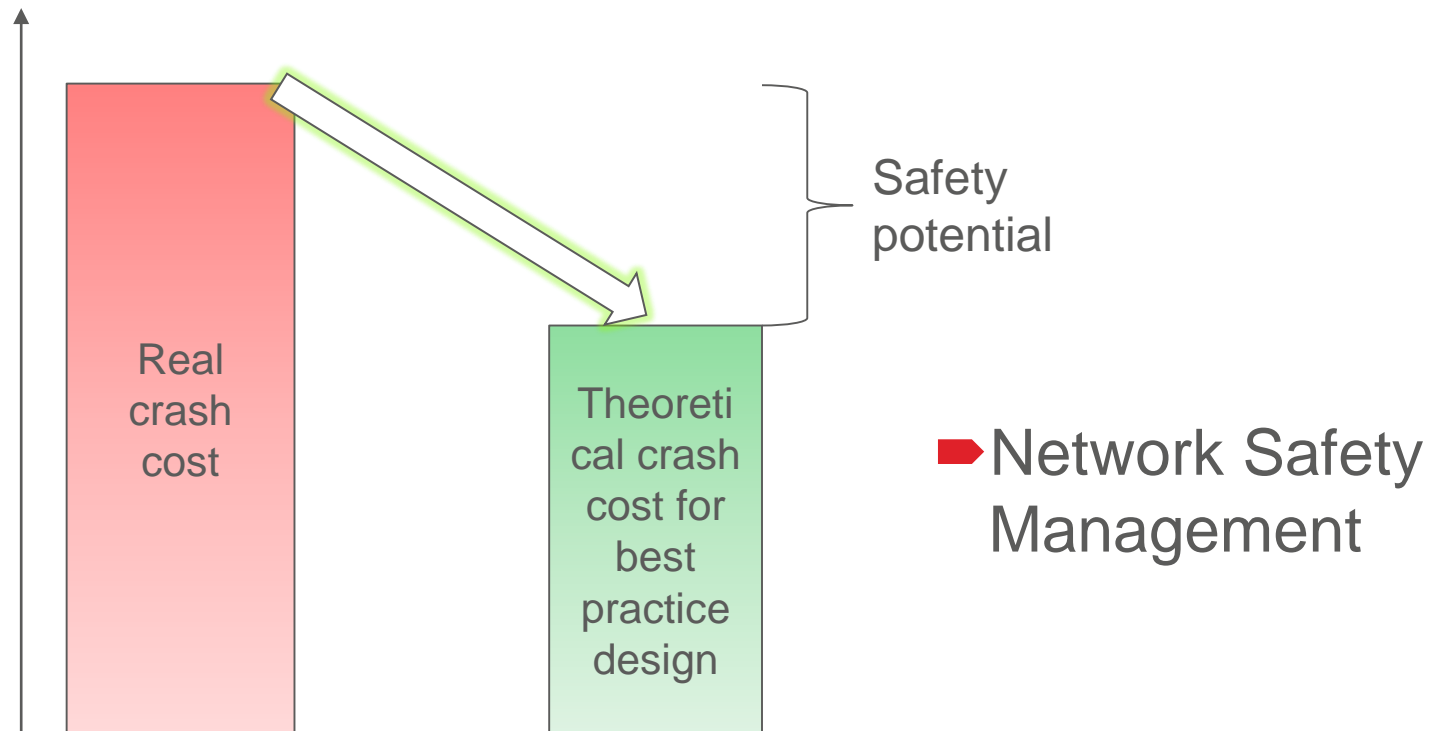
More than

50 % of avoidable accident costs

occur on only

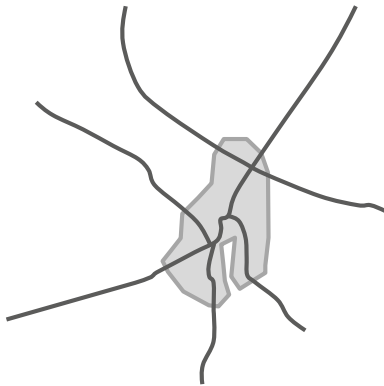
10% of the road network!

NETWORK SAFETY MANAGEMENT



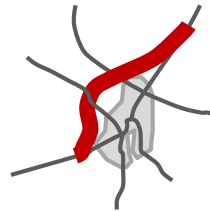
ROAD SAFETY IMPACT ASSESSMENT

Current status

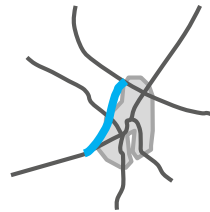


Layouts

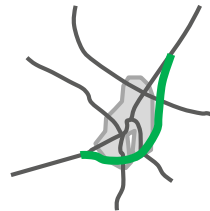
A



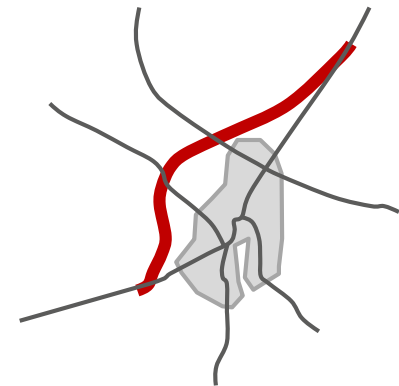
B



C



Safest Layout



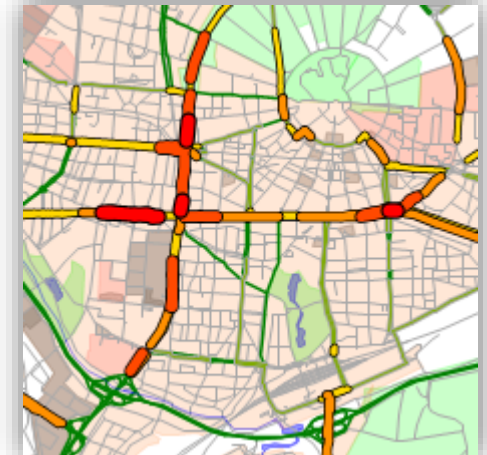
USE CASE ROAD IMPACT ASSESMENT BASED ON CRASH PREDICITON MODELLING



Road types



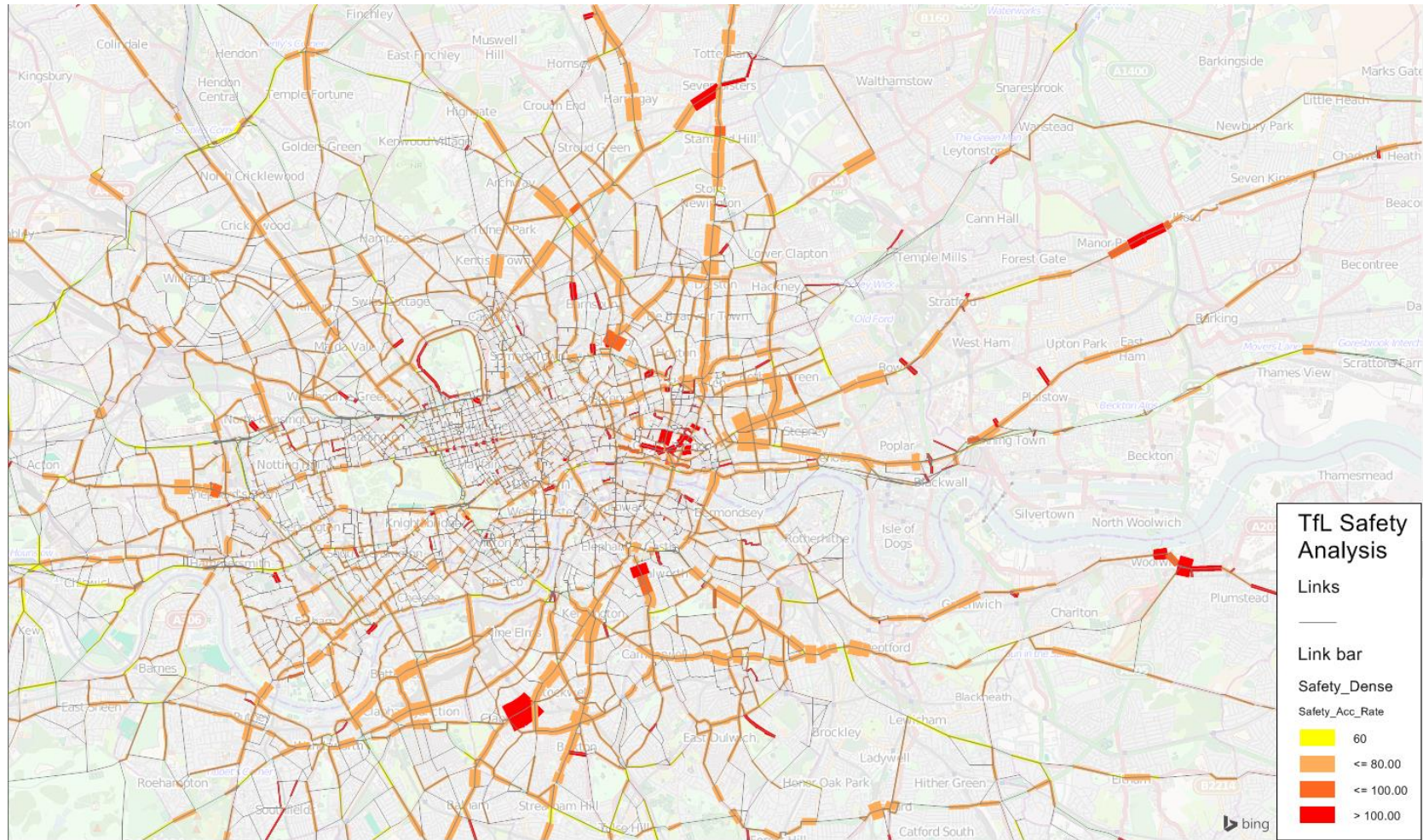
Accident rate



Accident density

- Calculate accident cost rates based on network attributes
- Use traffic model to calculate **expected accident cost**
- Compare different scenarios

EXAMPLE LONDON: ACCIDENT RATES & DENSITY ON LINKS



NETWORK SAFETY MANAGEMENT

Network analysis

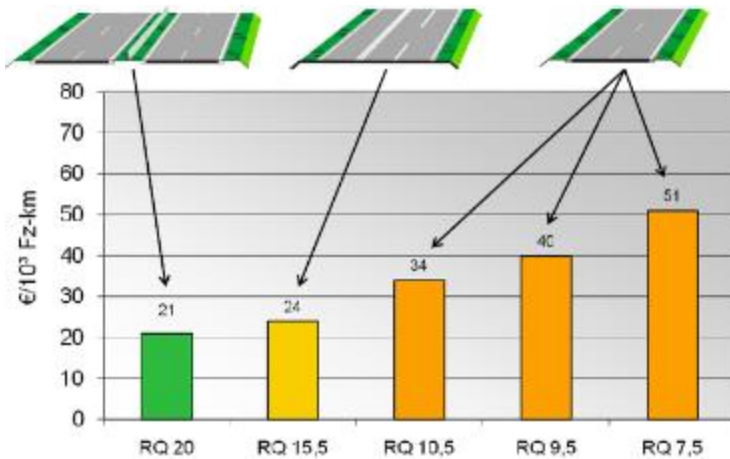
- Show accident density:
„Accidents per year per km“
- Show accident rate:
„Accidents per mio. vehicles per km“
- List these figures and sort them to find the worst roads in your network

NETWORK SAFETY MANAGEMENT

Network analysis

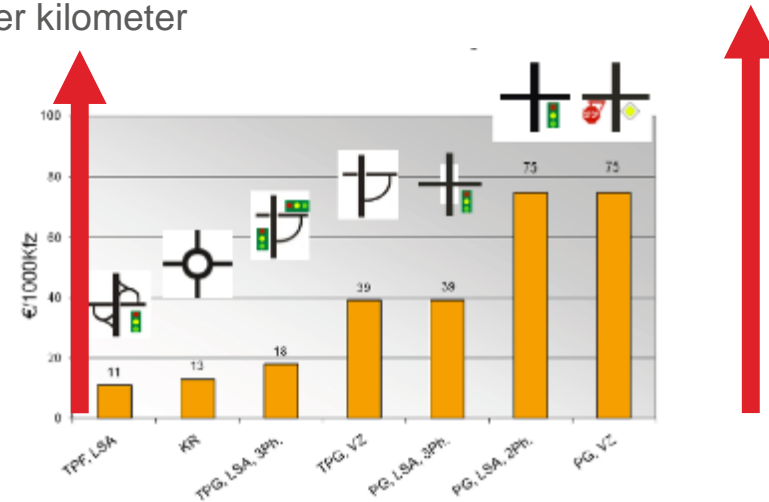
- Show accident density:
„Accidents per year per km“
- Show accident rate:
„Accidents per mio. vehicles per km“
- List these figures and sort them to find the high risk sections in the network

ROAD SAFETY IMPACT ASSESSMENT



Crash costs per 1000 vehicles per kilometer

Crash costs per 1000 vehicles

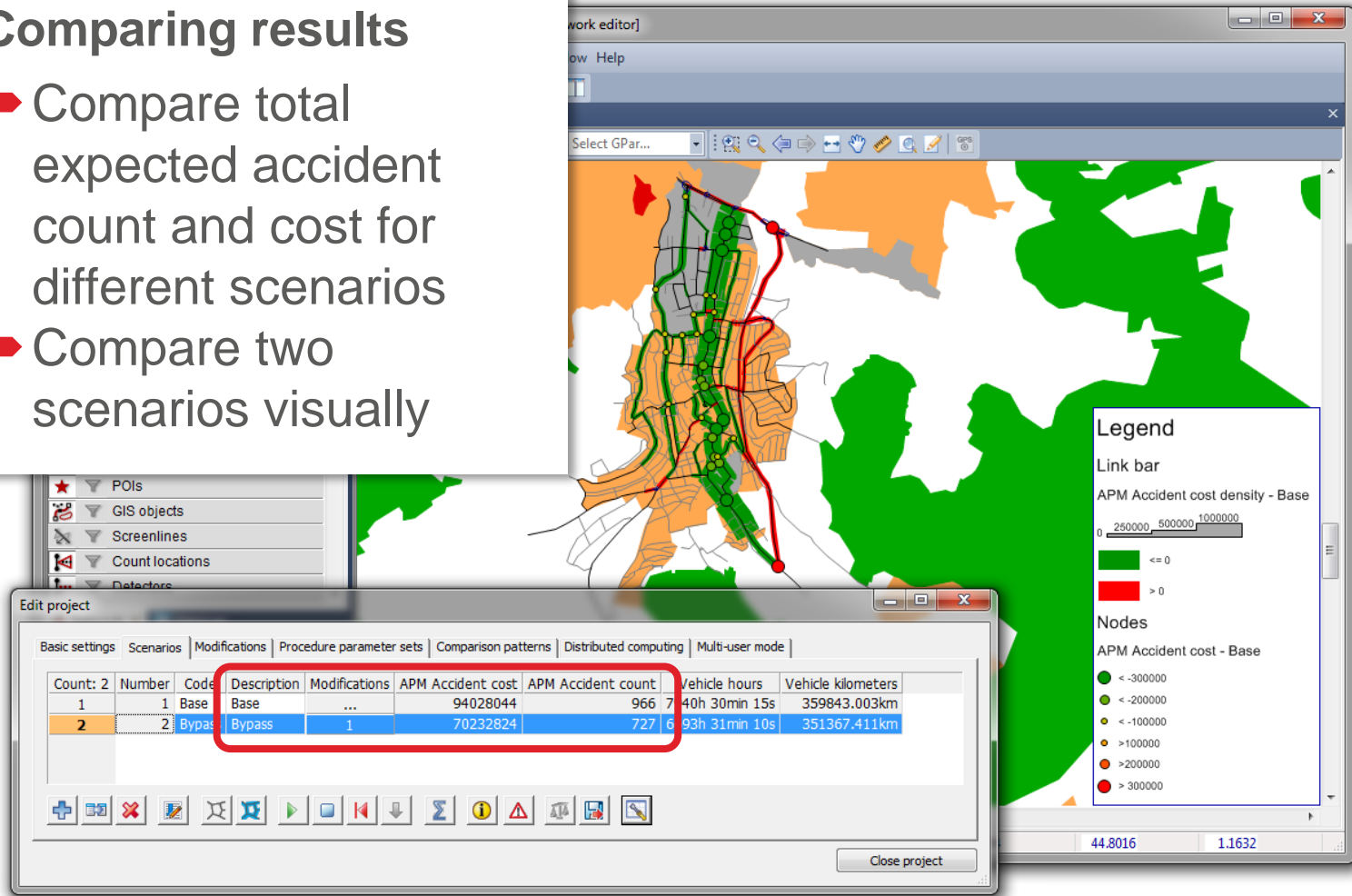


- Standardized valuation method for comparing newly planned alternative schemes
- Estimations of e.g. crash cost rates for different types of infrastructure (nodes and links)
- Cost-benefit-analysis of new construction or reconstruction

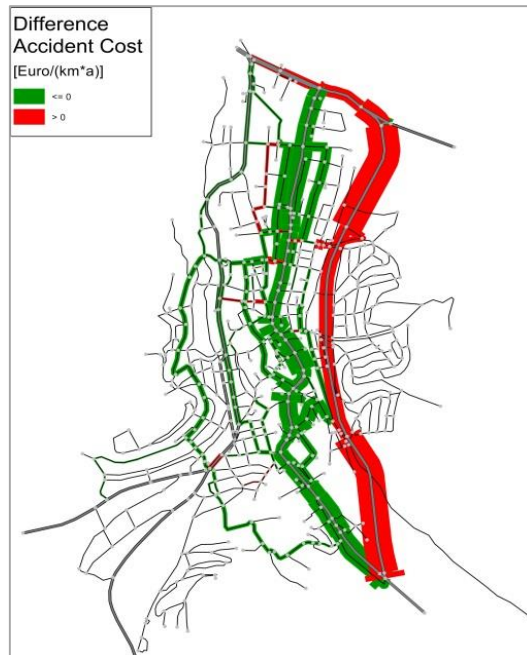
EVALUATION OF RESULTS

Comparing results

- Compare total expected accident count and cost for different scenarios
- Compare two scenarios visually

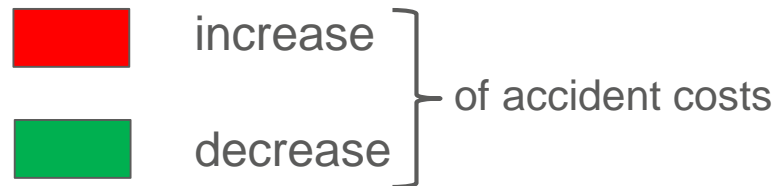


ROAD SAFETY IMPACT ASSESSMENT (RIA)

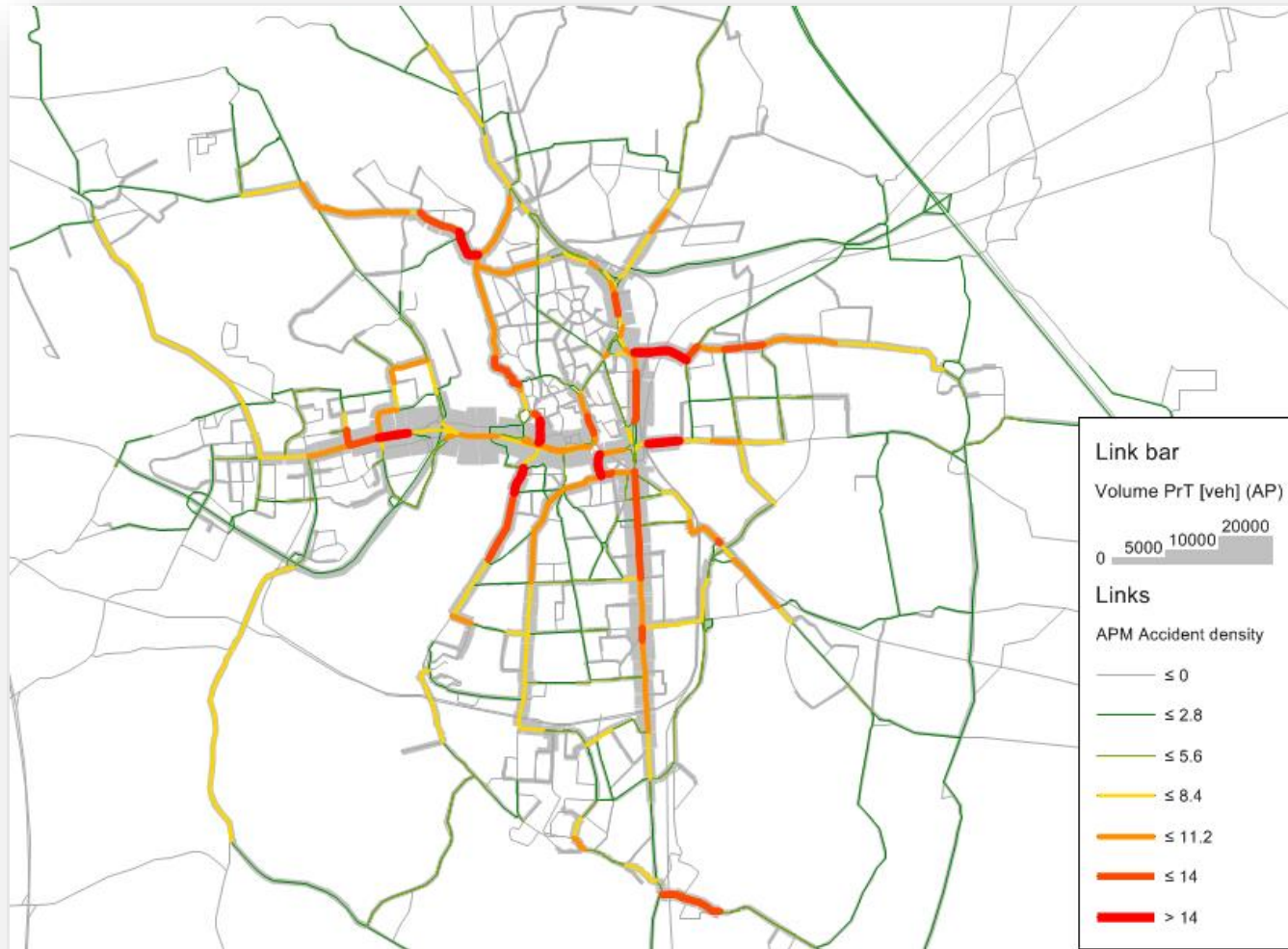


Estimation of the effects that changes in the amount and the distribution of traffic volumes have on the road network.

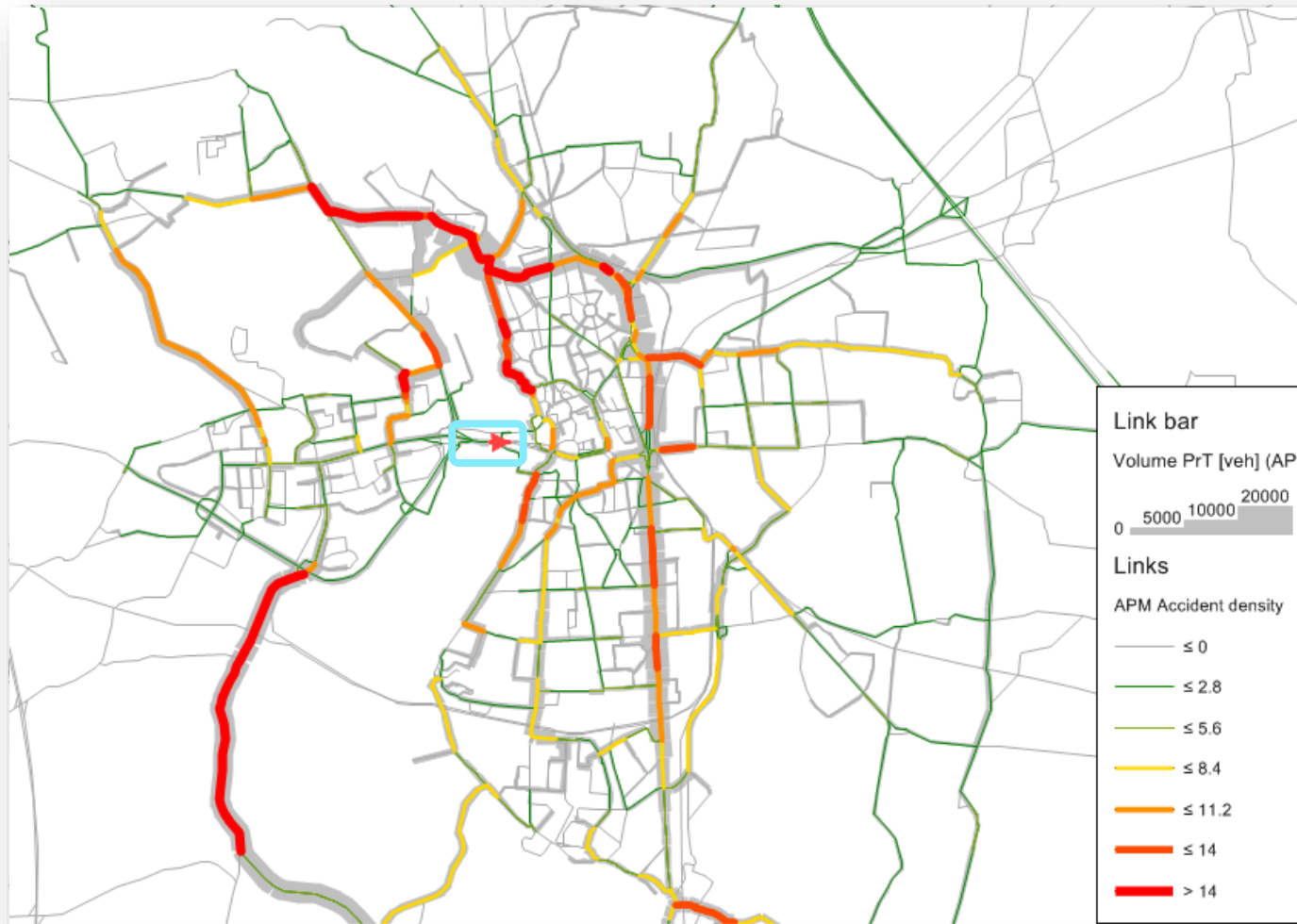
Example of new bypass and the impact on safety:



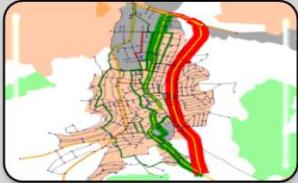
USE CASE TRAFFIC MANAGEMENT: REGULAR TRAFFIC VOLUME AND ACCIDENT DENSITY



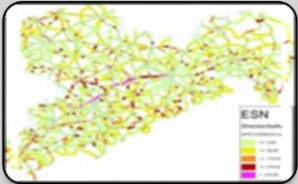
BRIDGE CLOSED: DIFFERENT TRAFFIC VOLUME AND ACCIDENT DENSITY



SCOPE OF APPLICATIONS FOR ROAD SAFETY



Road Impact Assessment (RIA)
Forecast of safety levels

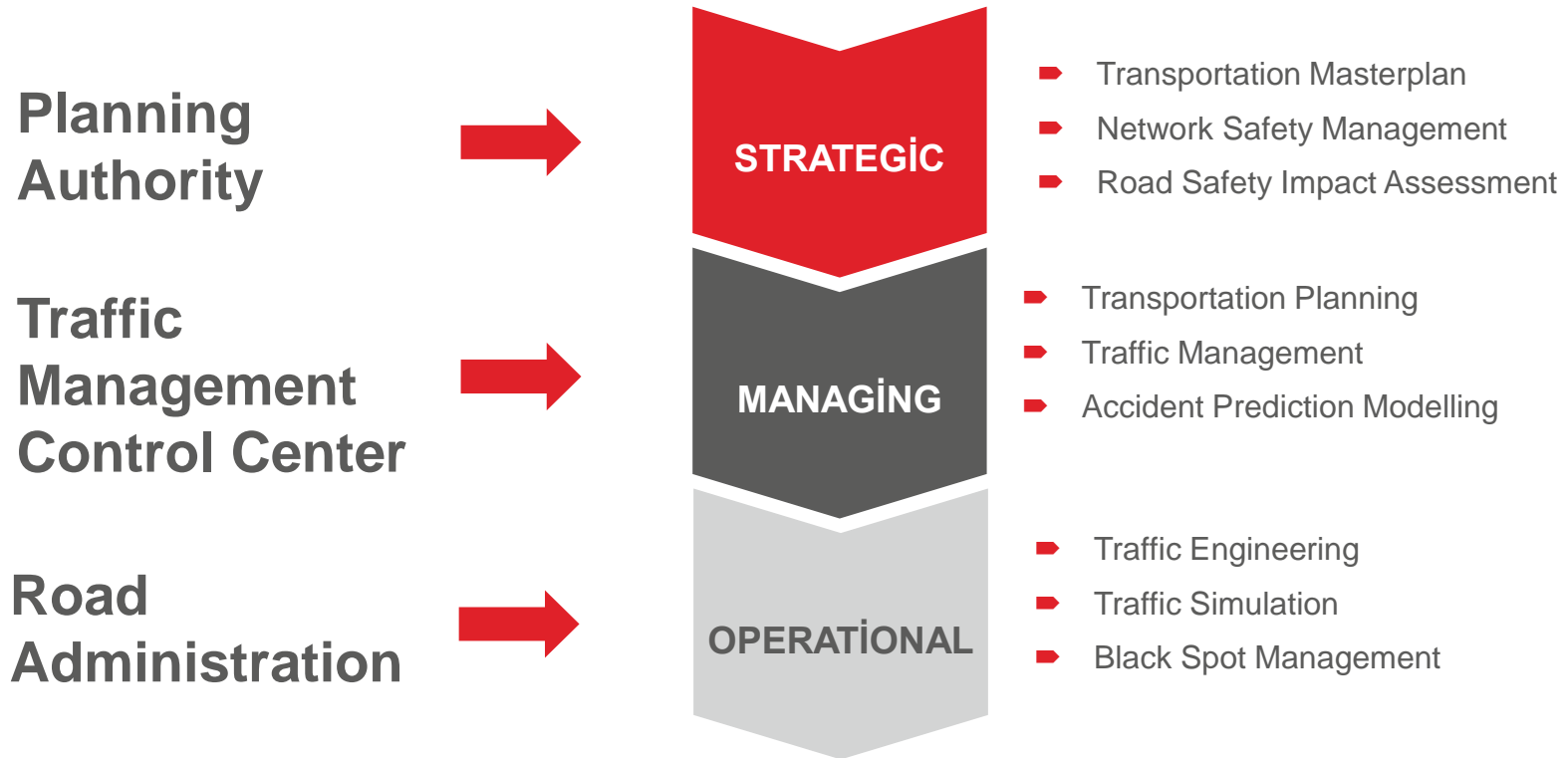


Network Safety Management (NSM)
Aggregation of safety data



Black Spot Management (BSM)
Detailed analysis of historical accident data

ADMINISTRATIONAL LEVELS OF SAFETY MANAGEMENT



**Safe and sustainable
road networks**



PTV GROUP

the mind of movement