

„Friedrich List“ Faculty of Transport and Traffic Sciences  
Chair of Integrated Transport Planning and Traffic Engineering  
Prof. Dr.-Ing. Regine Gerike

# Instruments for Safety Management in Road Traffic Black Spot Management



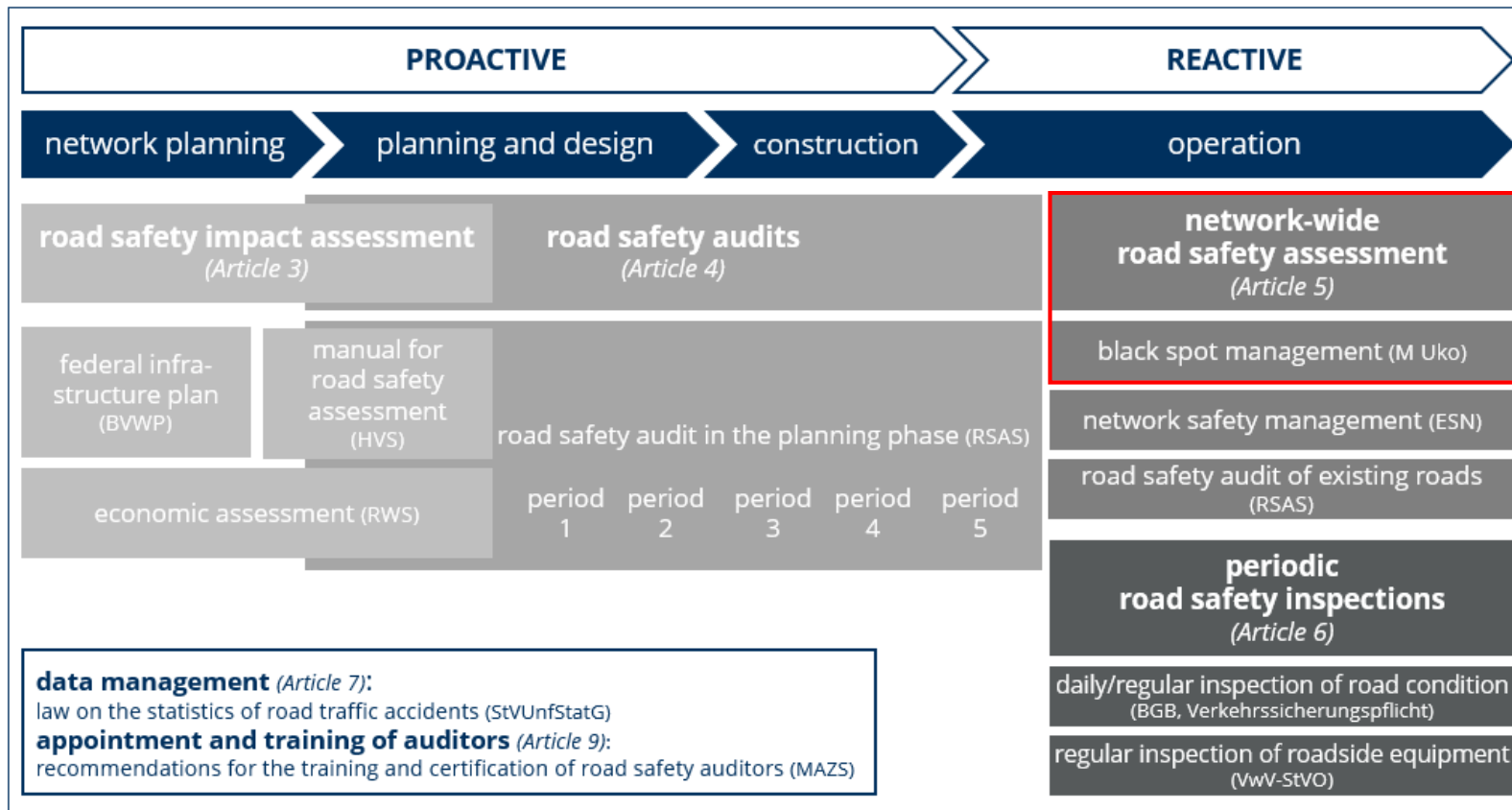
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of the European Union



# Instruments for Road Safety Management: Europe and Germany

## Black Spot Management

**Black Spot Management: Combating accident-prone areas in the road network based on the accidents that have already happened to avoid further accidents.**



Legal Framework EU:

- Directive 2008/96/EC, amended by EU Directive 2019/1936

Legal Framework Germany:

- Road Traffic Regulations (§ 44, StVO)
- Road and Transportation Research Association (FGSV):
- Recommendation on local accident investigation (M Uko)

[FGSV, 2019]

# Accident Commission

## Participants

### regular participants

- police
  - recording of accidents, accident analysis
  - traffic monitoring
- road traffic authority
  - orders on traffic sign arrangement
- road construction authority
  - execution of orders
  - implementation of measures for road construction and operation

### other possible regular or temporary participants

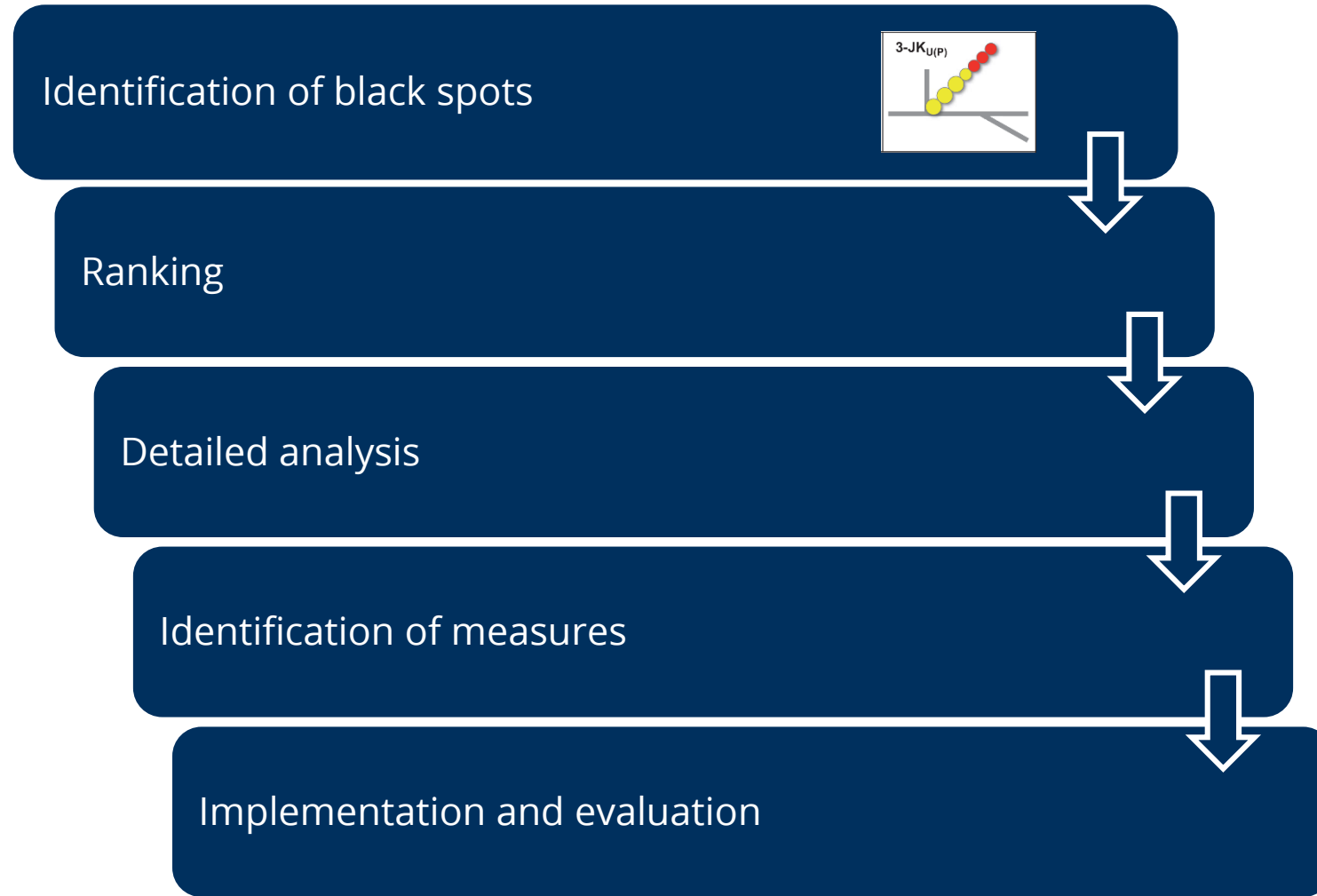
- academia
- local public transport provider



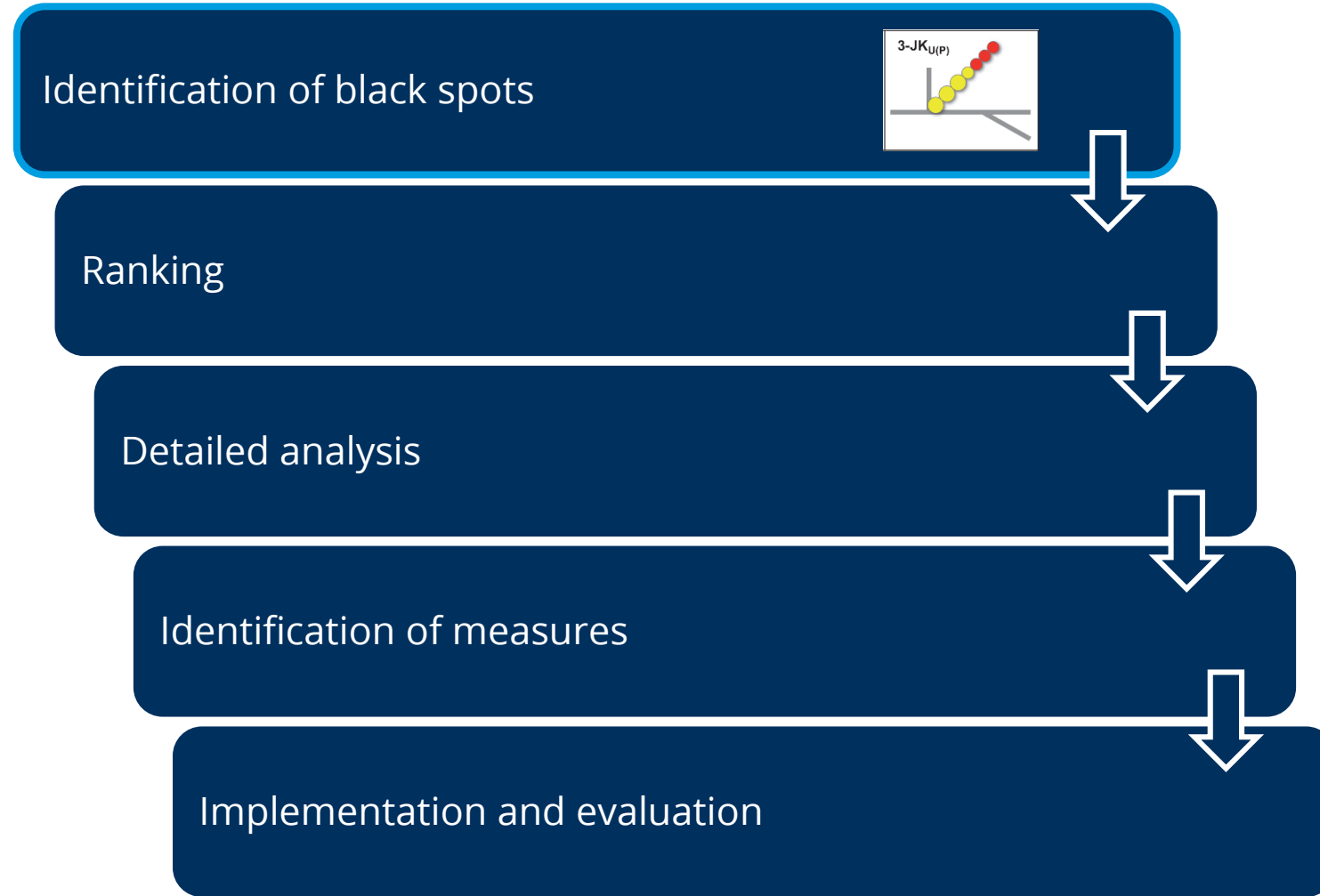
Figure [1]

- regular meetings
- joint implementation of the local accident investigation

# Black Spot Management Process



# Black Spot Management Process



# Black Spot Management

## Identification of Black Spots

### **black spot**

- location within the road network where accidents occur repeatedly

### **separate identification of all accidents and accidents with personal injuries**

- accidents with personal injuries:
  - occur less frequent than accidents with only property damage
  - could happen at different locations than property damage accidents

# Black Spot Management

## Identification of Black Spots

### requirements for observation periods

- as long as necessary so that randomness does not lead to the detection of a black spot
- as short as possible to be able to combat black spots as quickly as possible
- no change road design or operation

### determinations

- one map with all accidents during 1 year (urban areas)
- one map with accidents with personal injuries during 3 years
- longer time periods for special tasks (e.g. motorcycle accidents, tree accidents)
- time periods in whole years to consider of seasonal fluctuations

# Black Spot Management

## Identification of Black Spots

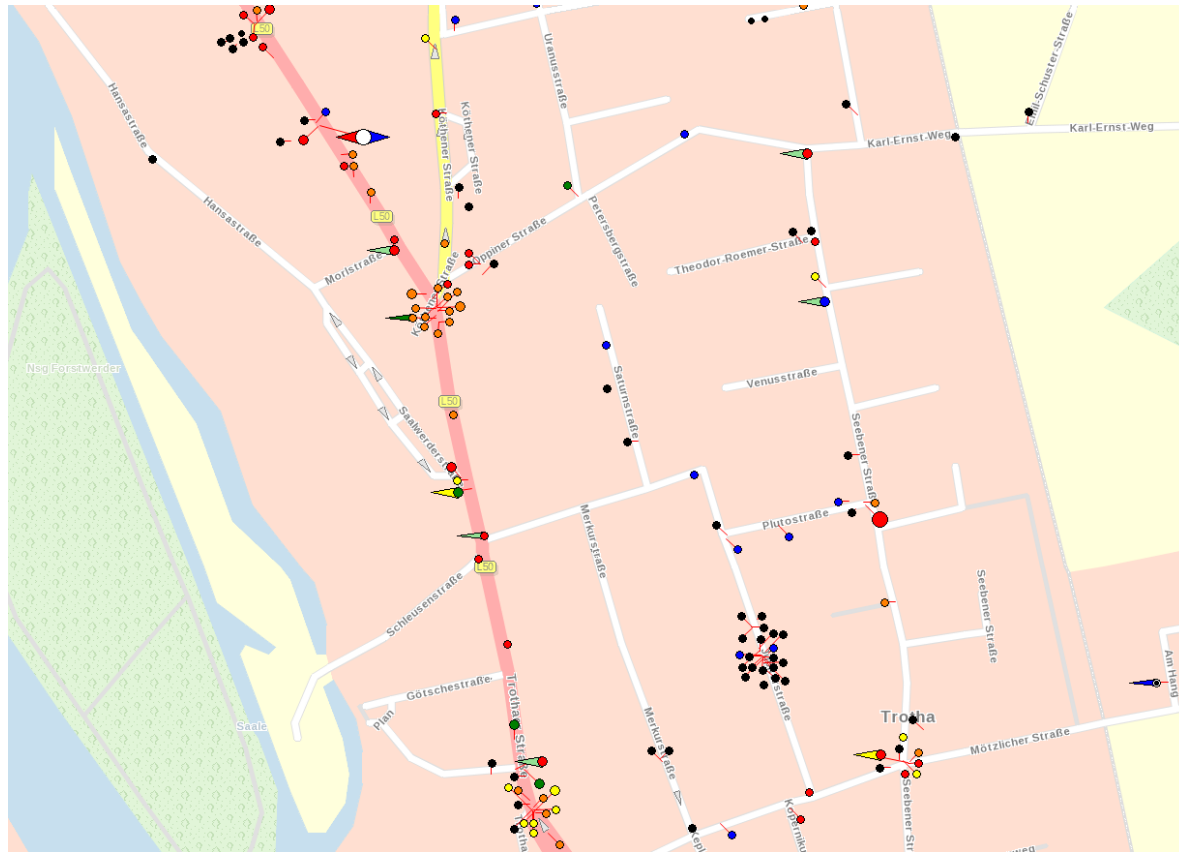


Figure [2]

Basis: electronic map with accidents

symbol	accident type	
● (green)	1	driving accident
● (yellow)	2	turn accident
● (red)	3	turn off/crossing accident
◀ (white)	4	exceeding-accident
● (blue)	5	accident due to stationary traffic
● (orange)	6	accident in parallel traffic
● (black)	7	other accident

special characteristics	
◀ (red)	pedestrian
◀ (green)	tree
◀ (light green)	cyclist
◀ (blue)	alcohol
◀ (yellow)	motorcyclist
◀ (purple)	overtake
◀ (brown)	game

[FGSV 2012]



# Black Spot Management

## Identification of Black Spots

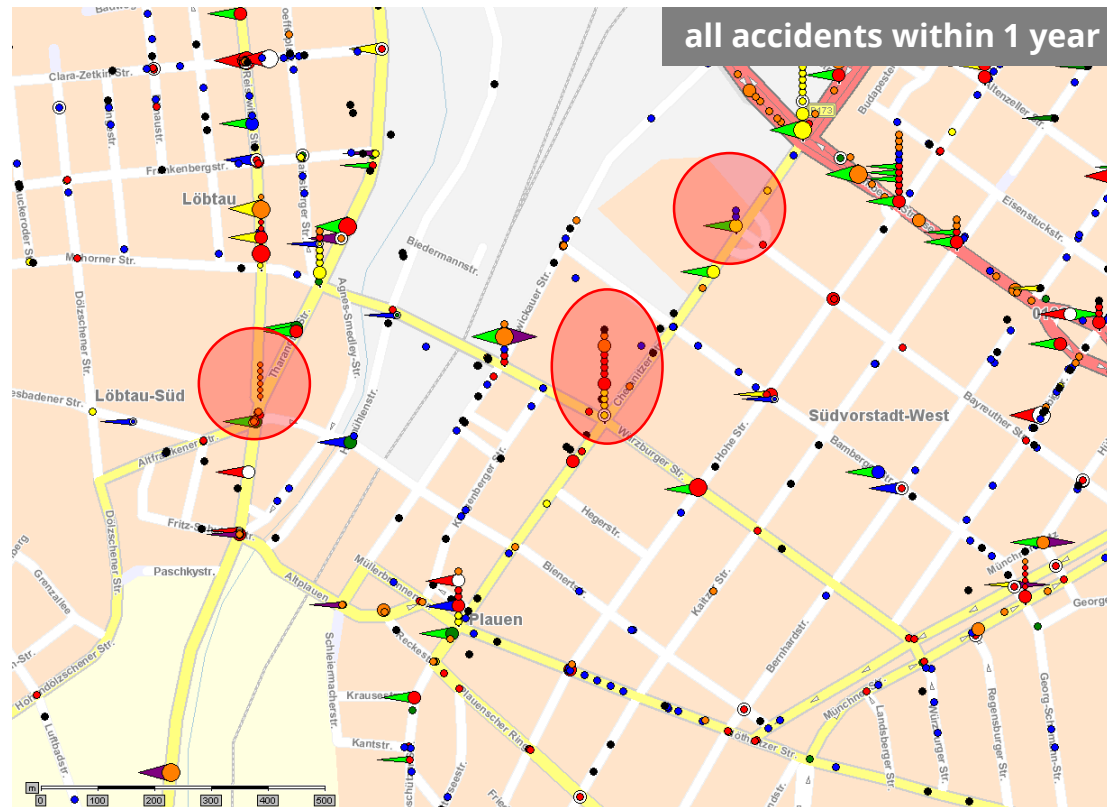


Figure [3]

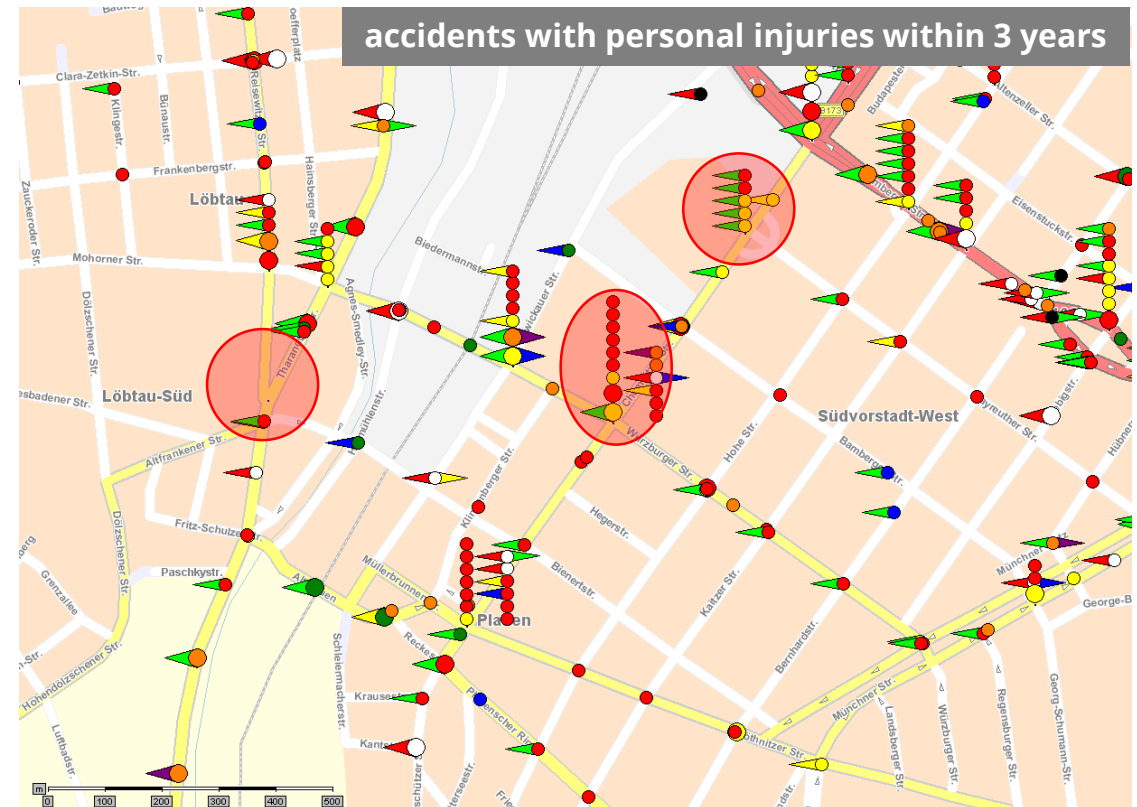


Figure [4]

# Black Spot Management

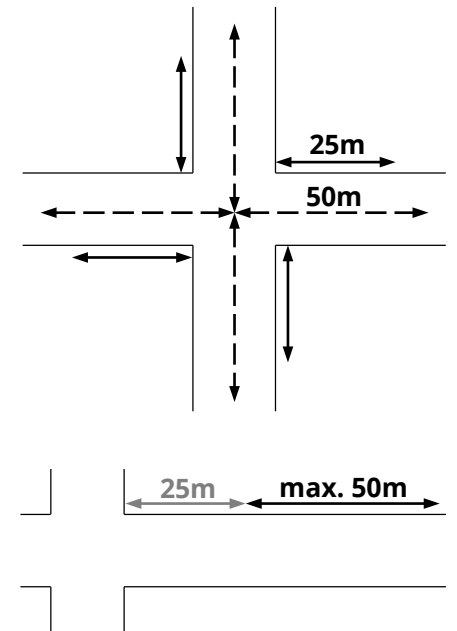
## Identification of Black Spots

### types of black spots

- accidents at **junctions** or accidents on **road sections**
- **slight** (visible in the 1-year map) or **serious** (visible in the 3-year map)

### black spot thresholds *in urban areas*

- at junctions:
  - 1-year map: 5 accidents of the same type (driving accident, turn accident etc.)
  - 3-year map: 5 accidents
  - 15 accidents of the same type during 12 months → mass black spot
- on road sections:
  - 1-year map: 5 accidents of the same type (driving accident, turn accident etc.)
  - 3-year map: 5 accidents
- linear black spots (on road sections):
  - 3-year map: 3 exceeding-accidents (up to 300m between each other, variable total length)



# Black Spot Management

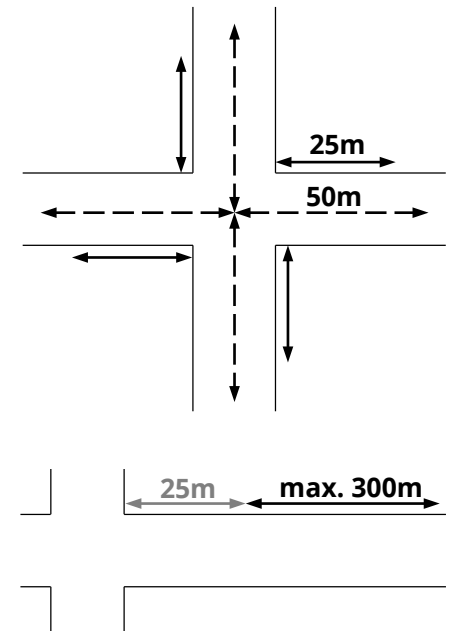
## Identification of Black Spots

### types of black spots

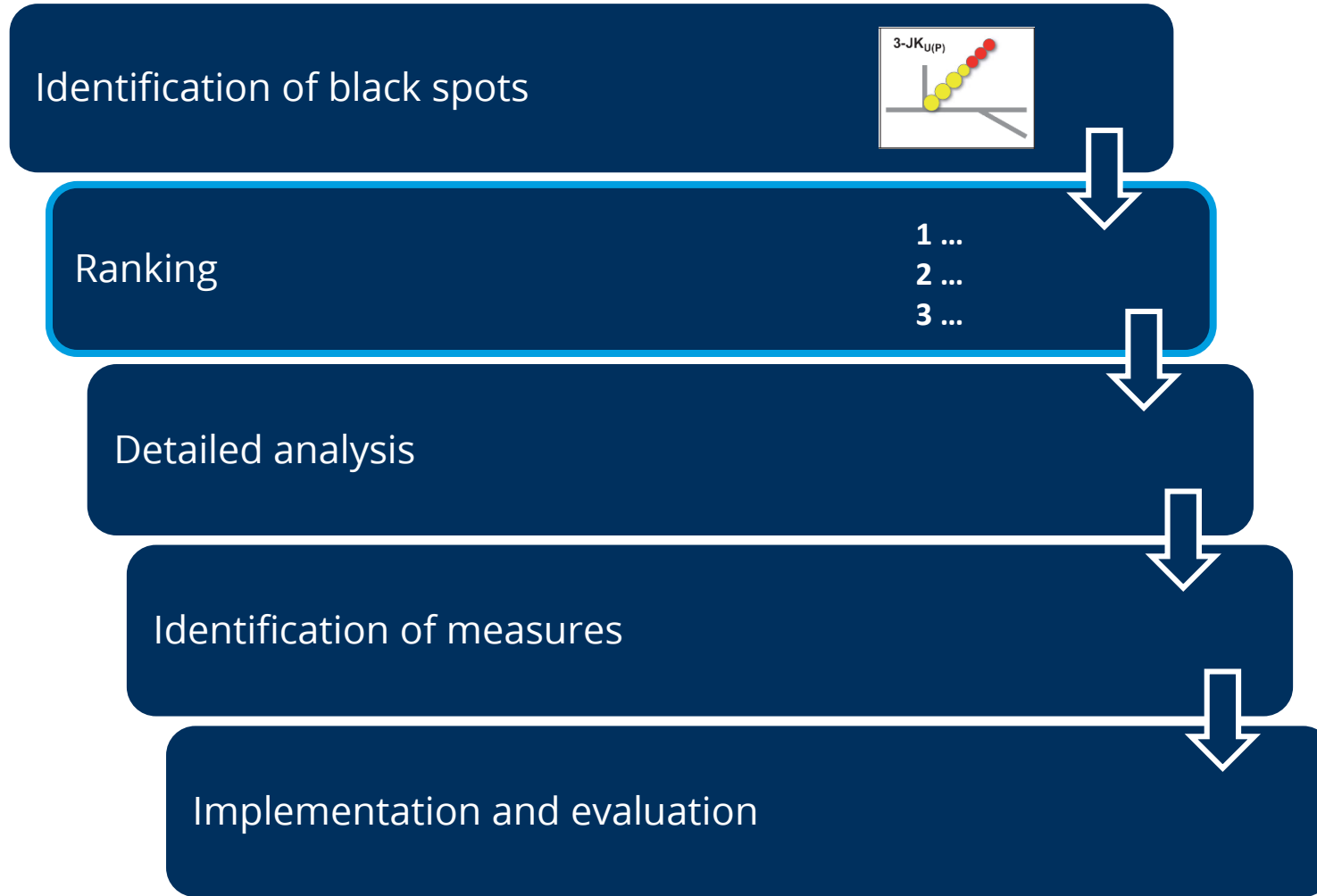
- accidents at **junctions** or accidents on **road sections**
- **slight** (visible in the 1-year map) or **serious** (visible in the 3-year map)

### black spot thresholds *outside urban areas*

- at junctions:
  - 3-year map: accidents (fatal/serious injuries) \* 5 + accidents (slight injuries) \* 2  $\geq$  15
- on road sections:
  - 3-year map: accidents (fatal/serious injuries) \* 5 + accidents (slight injuries) \* 2  $\geq$  15
- linear black spot (on road sections):
  - 3-year map: 3 accidents with a distance up to 600m between each other (variable total length)



# Black Spot Management Process



# Black Spot Management

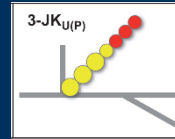
## Ranking of Black Spots

### Where to start?

- prioritization according to the number of accidents or to the accident costs
- prioritization according to the accident severity
- goal: complete execution

# Black Spot Management Process

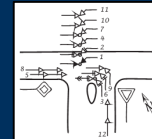
Identification of black spots



Ranking

- 1 ...
- 2 ...
- 3 ...

Detailed analysis



Identification of measures

Implementation and evaluation

# Black Spot Management

## Detailed Analysis of Black Spots

### documents/methods

- accident maps (extract of the Electronic accident type map)
- accident lists
- accident diagrams
- site visit
- collection of further data if necessary

# Black Spot Management

## Detailed Analysis of Black Spots

### accident lists

[FGSV 2012]

City: .....							<b>Black Spot</b>		
Location: .....							<input checked="" type="checkbox"/> slight		
Time: .....							<input type="checkbox"/> serious		
Area: .....							<input type="checkbox"/> line      Length = ..... km		
Number: .....									
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Month	Jan	May					December-March		30%
Day	Sa	Wed					Saturday/Sunday		20%
Time	15	21					6-9/16-19		40%
Light conditions	bright	dark					dark		25%
Road conditions	wet	dry					wet/frozen		30%
Number of fatalities	0	1					<i>total number of fatalities</i>		
Serious injuries	0	2					<i>total number of serious injuries</i>		
Slight injuries	2	0					<i>total number of slight injuries</i>		
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Number of involved persons	2	2					<i>total number of single vehicle accident</i>		
Accident category (severity)	3	1					<i>most frequent</i>		
Accident type	3	3					<i>most frequent</i>		
Kind of accident	5	5					<i>most frequent</i>		
Accident causes	28	28					<i>most frequent</i>		



# Black Spot Management

## Detailed Analysis of Black Spots

### accident lists

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- characteristics of black spot
- one list of 1-year map
- one list of 3-year map

# Black Spot Management

## Detailed Analysis of Black Spots

### accident lists

[FGSV 2012]

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- characteristics of accidents
- basis: accident reports

# Black Spot Management

## Data basis

### accident reports

- recorded by the police
- contains information about:
  - accident circumstances → date, time, day of week, light conditions, road conditions
  - accident severity → categorie, number of fatalities/serious injuries/slight injuries
  - accident location → urban/extra-urban
  - accident type → description of the causing traffic operation (7 different types)
  - kind of accident → direction of movement of the participants in relation to each other during the first collision or the first other mechanical impact
  - accident causes → e.g. effects of weather, road conditions, inappropriate speed, failure to observe the right of way

# Black Spot Management

## Detailed Analysis of Black Spots

### accident lists

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– summary of certain characteristics

A(F+SI) – 3-year map accidents with fatal and serious injuries

A(I) – 3-year map accidents with injuries

A – 1-year map (all) accidents

# Black Spot Management

## Detailed Analysis of Black Spots

### accident lists

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finding ***structural*** similarities in accident events

- accident circumstances
  - winter service
  - leisure traffic
  - peak traffic times
  - identifiability (lighting)
  - grip

# Black Spot Management

## Detailed Analysis of Black Spots

### accident lists

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finding ***structural*** similarities in accident events

- characteristics of involved road users and injuries

# Black Spot Management

## Detailed Analysis of Black Spots

### accident lists

[FGSV 2012]

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finding ***structural*** similarities in accident events

– characteristics of accidents

# Black Spot Management

## Detailed Analysis of Black Spots

### accident diagrams

- finding ***spatial similarities*** in accident events
- derive possible deficits
- arrows with certain meanings regarding to
  - kind of involved persons/vehicles
  - direction of movement
  - most serious accident consequence
  - road conditions
  - light conditions
  - special driving status (e.g. drive backwards)
  - other information (e.g. blood alcohol)

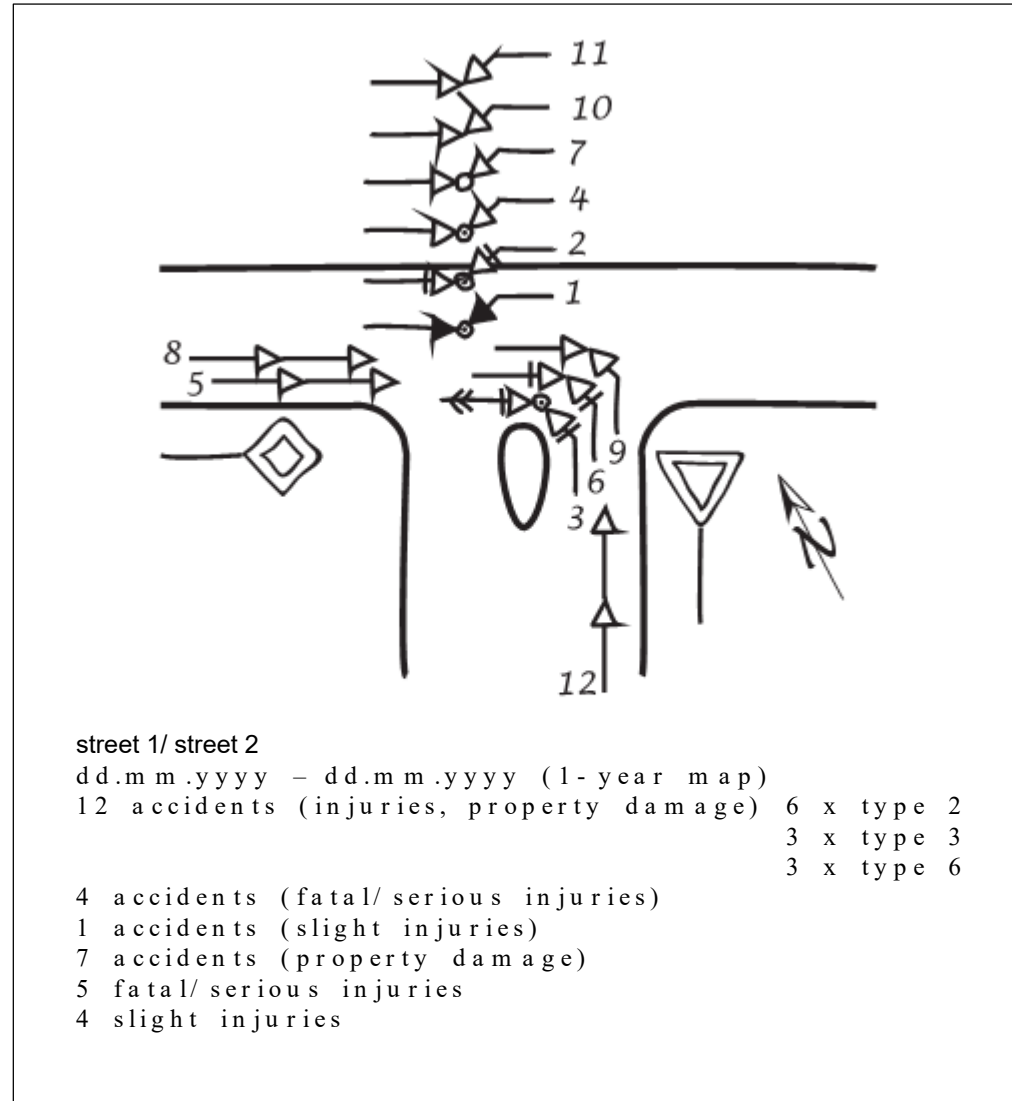


Figure [5]



# Black Spot Management

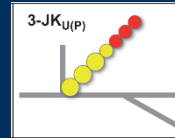
## Detailed Analysis of Black Spots

### site visit

- finding deficits regarding infrastructure, operation or environment
- using findings and knowledge from accident lists and accident diagrams
  - e.g. day/time of site visit from accident list (maybe accidents happen most frequent in darkness)
- analysing all possible views and perspectives of road users (taking pictures)
- observation of moving and stationary traffic
- additional investigations: speed measurement, measurement of waiting times, ...
- to be checked at junctions:
  - Identifiability (Can you notice that there is a junction?)
  - Comprehensibility (Can you notice what you have to do? Who has the right of way?)
  - Visibility of other road users
  - Passability (enough space, assistance for disabled people)

# Black Spot Management Process

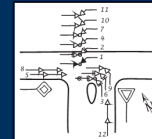
Identification of black spots



Ranking

1 ...  
2 ...  
3 ...

Detailed analysis



Identification of measures



Implementation and evaluation

# Black Spot Management

## Finding Measures Against Black Spots

- discussion and consideration of possible measures in the accident commission (using of experiences, literature)

### **immediate measures**

- to be implemented in any case
- e.g. new or changed marking, speed control

### **medium- to long-term measures**

- e. g. stationary speed control, roundabout, traffic lights with left turn protection

# Black Spot Management

## Finding Measures Against Black Spots

### Literature

2009

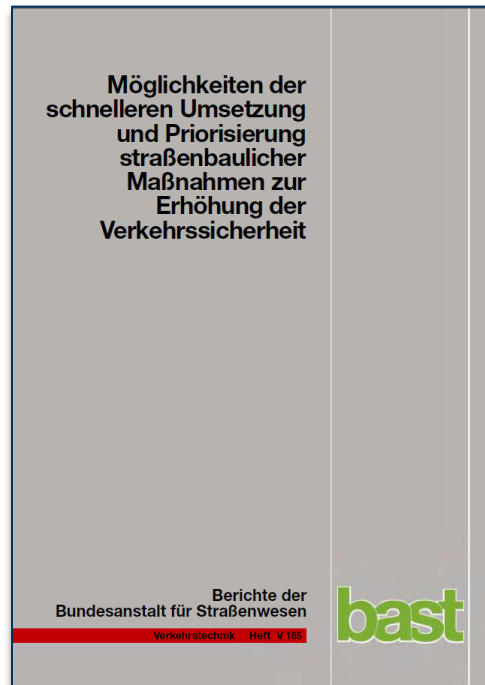


Figure [6]

2011

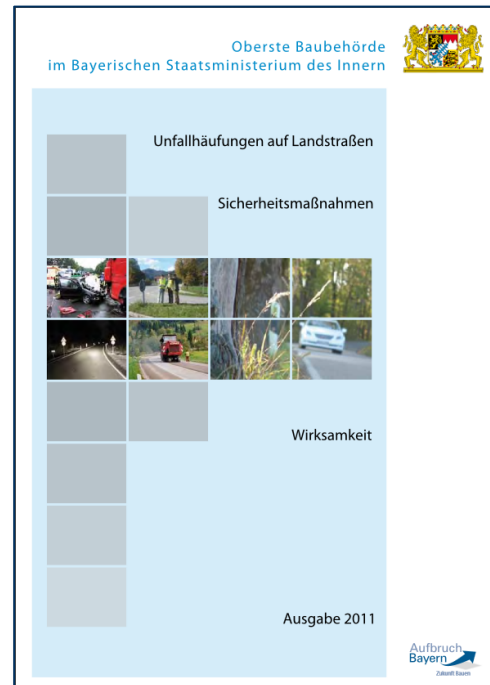


Figure [7]

2016

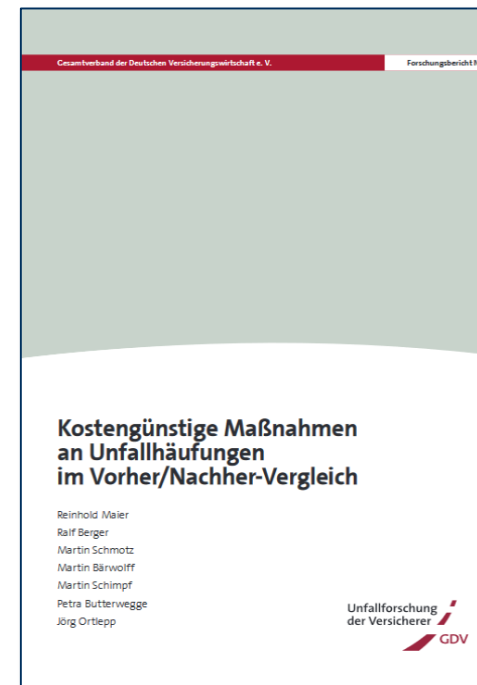


Figure [8]

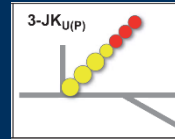
2019



Figure [9]

# Black Spot Management Process

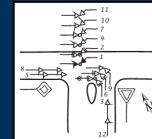
Identification of black spots



Ranking

- 1 ...
- 2 ...
- 3 ...

Detailed analysis



Identification of measures



Implementation and evaluation



# Black Spot Management

## Evaluation of Implemented Measures

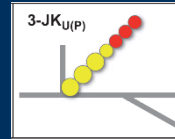
**To what extent has the measure increased road safety?**

$$\text{Impact of measure [\%]} = 1 - \frac{\text{accident costs}_{\text{after}}}{\text{accident costs}_{\text{before}}}$$

→ impact should be in the high double digits

# Black Spot Management Process

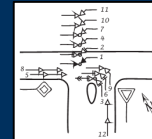
Identification of black spots



Ranking

- 1 ...
- 2 ...
- 3 ...

Detailed analysis



Identification of measures



Implementation and evaluation



# References

The extract from FGSV book number 298, *Richtlinien für das Sicherheitsaudit von Straßen. RSAS*, edition 2019, is quoted with permission of Forschungsgesellschaft für Straßen- und Verkehrswesen e.V. (Road and Transportation Research Association). Decisive for the use of FGSV books is the latest edition, which is available from FGSV Verlag (FGSV Publishing House), Wesselinger Str. 15-17, 50999 Köln, [www.fgsv-verlag.de](http://www.fgsv-verlag.de). (content translated into English)

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# List of Figures

[1] Image by 1st-christian from [Pixabay](#) (last access: 03-2022)

[2], [3], [4]

EUSka (PTV-Group): Electronic accident type map (german: Elektronische Unfalltypensteckkarte)

[5] The extract from FGSV book number 316/1, *Merkblatt zur örtlichen Unfalluntersuchung in Unfallkommissionen. M Uko*, edition 2012, is quoted with permission of Forschungsgesellschaft für Straßen- und Verkehrswesen e.V. (Road and Transportation Research Association). Decisive for the use of FGSV books is the latest edition, which is available from FGSV Verlag (FGSV Publishing House), Wesseling Str. 15-17, 50999 Köln, [www.fgsv-verlag.de](http://www.fgsv-verlag.de). (figure translated into English)

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