Road Safety Audit

Ghazwan Al-Haji, Ph.D
Department of Science and Technology
LINKÖPING UNIVERSITY
Sweden
ghaal@itn.liu.se

Contents

- Introduction to urban road safety
- Definitions of RSA and RSAR
- Background of RSA development
- RSA objectives
- How to conduct a RSA report?
- Selected items of the RSA checklist

2 out of 3 accidents happen in urban roads
2 killed of 3 are vulnerable users in urban roads

Fatalaties **Accidents**

Urban roads

30% ←  → **70%**

Rural roads

70% ←  → **30%**

Different purposes of urban roads

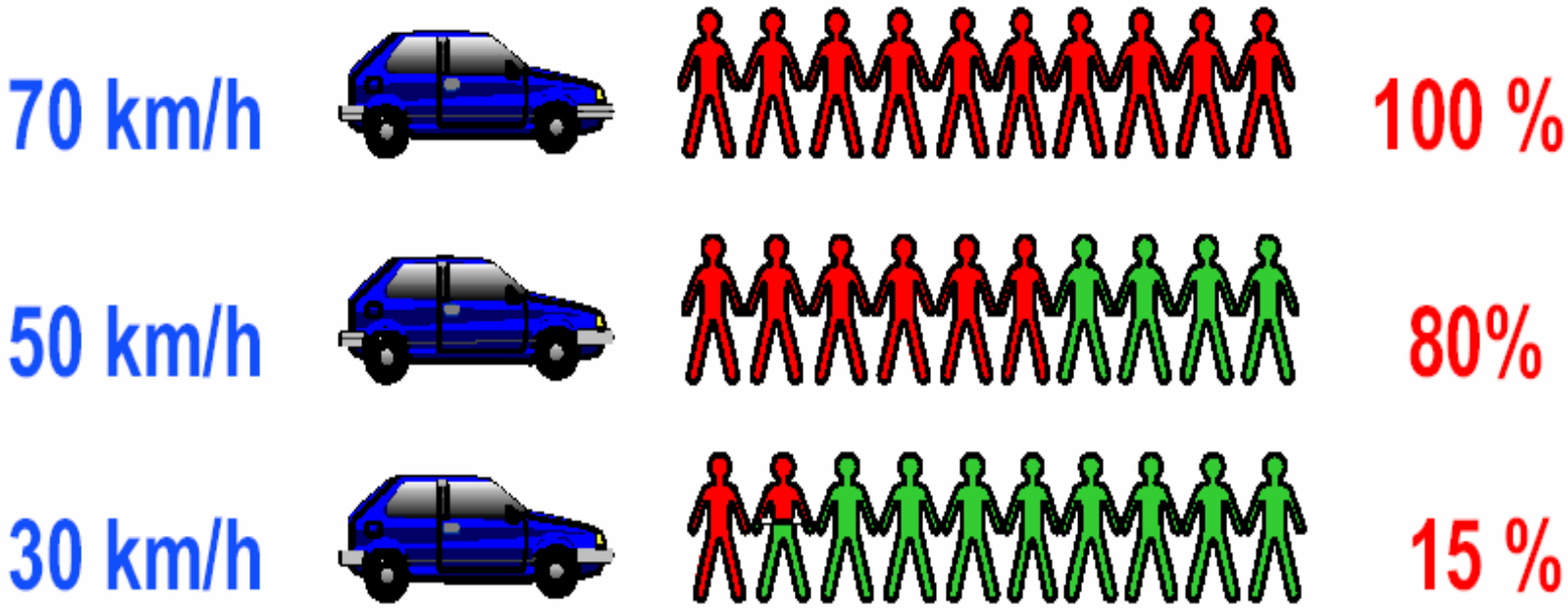




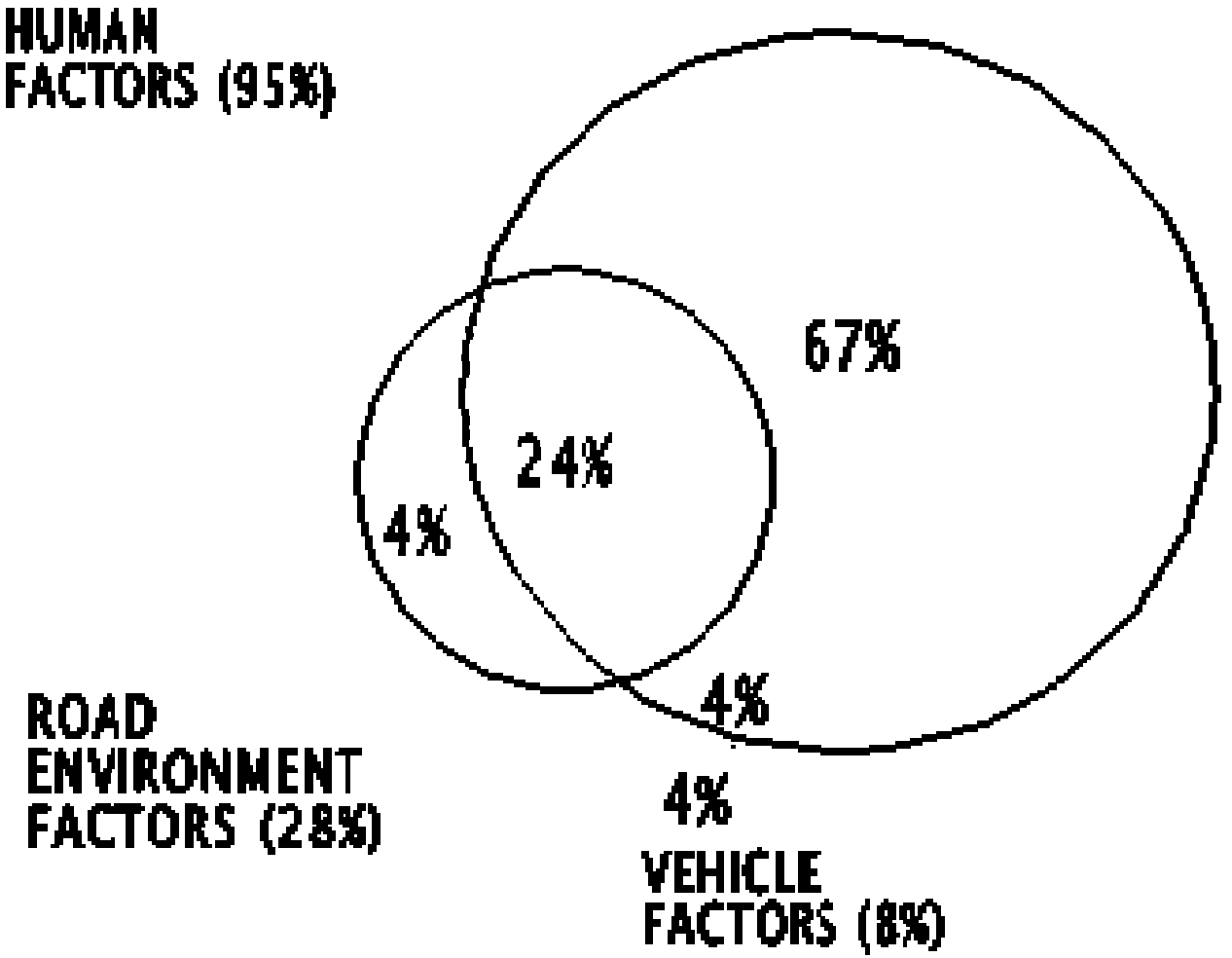




Speed and probability of fatal injury for a pedestrian



Shared Factors in Road Accidents



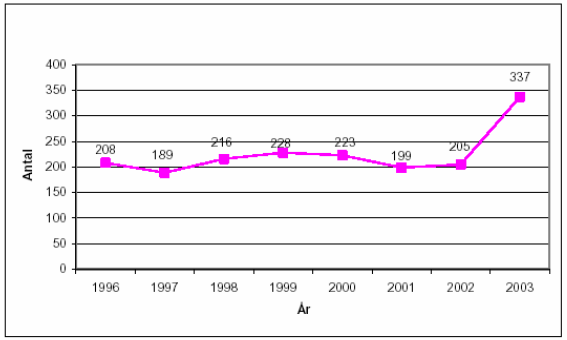
Road safety strategy : two main stages

1. **Knowing and understanding road safety problems**

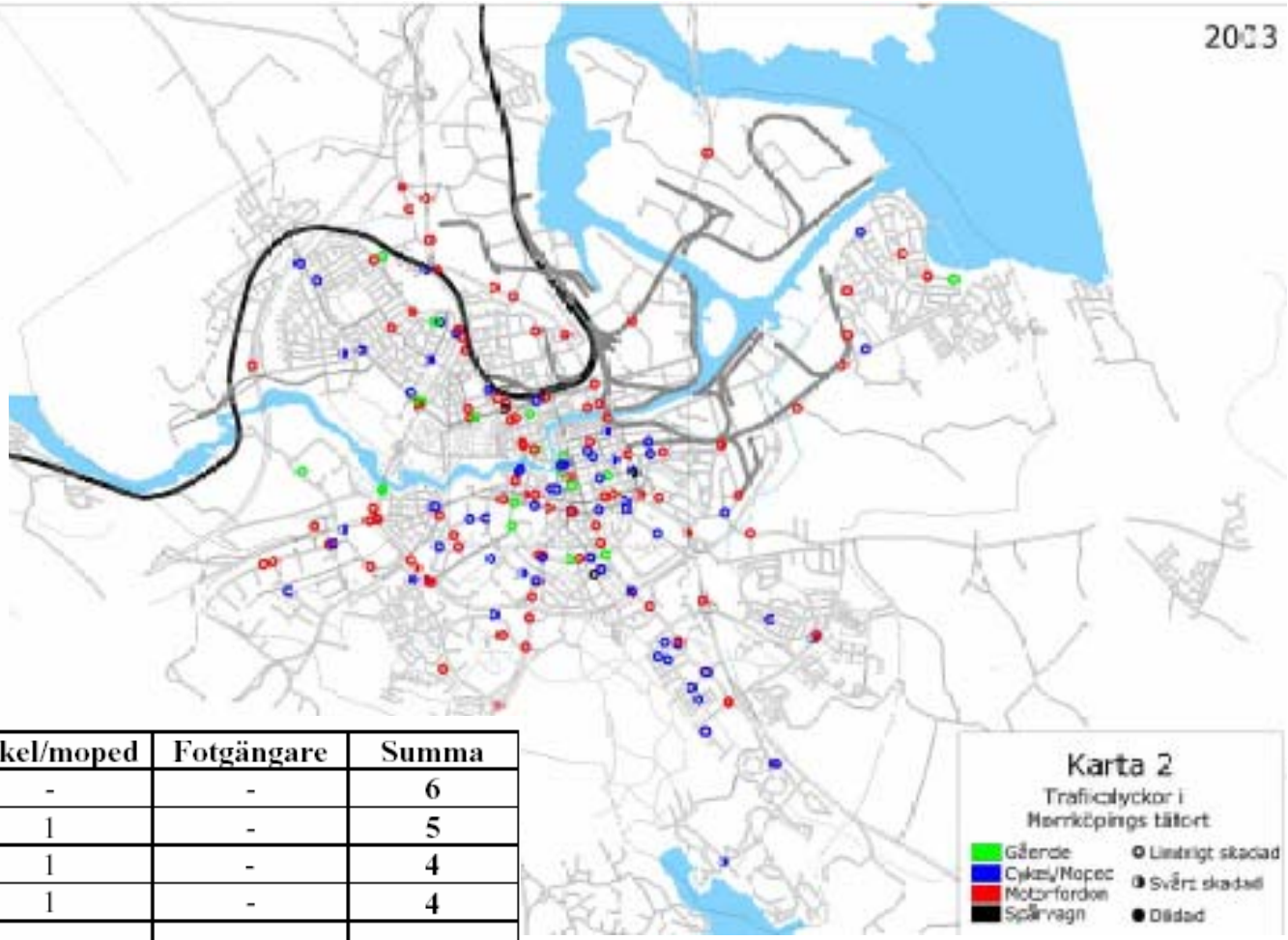
   Accidents data collection and analysis

2. **Setting up appropriate countermeasures, according the diagnosis data and experiences**

Knowing road safety problems: Analysis of accidents data (figures, tables, maps…)

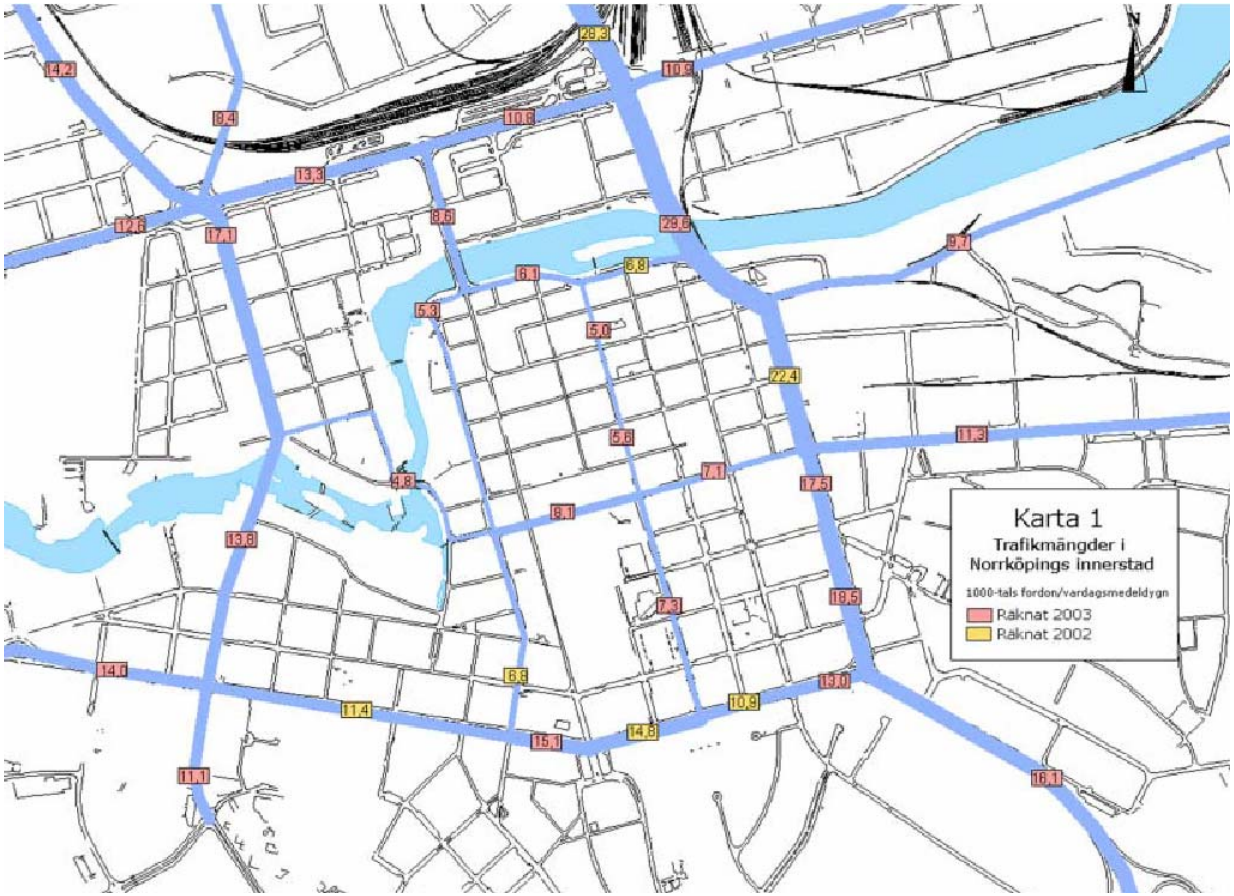


Figur 10: Antal dödade och skadade trafikanter i Norrköpings tätort (1996 - 2003).



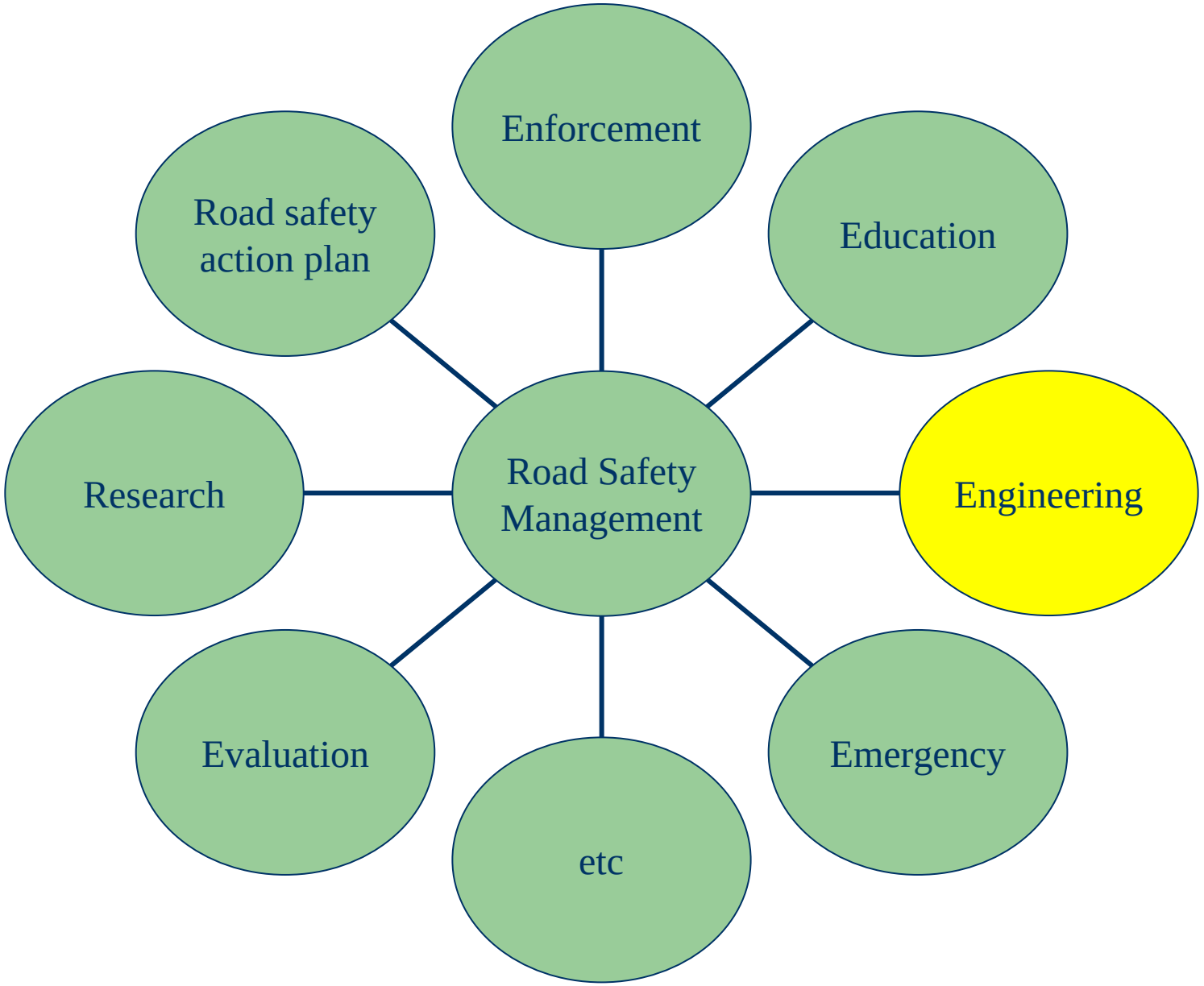
Plats	Motorfordon	Cykel/moped	Fotgängare	Summa
Tpl Kneippen	6	-	-	6
Tpl Skarphagen	4	1	-	5
Stockholmsrondellen	3	1	-	4
Söderleden/Hagebyg.	3	1	-	4
Albrektsvägen/ Gamla Övägen	3	1	-	4
Södra promenaden/ Hörngatan	2	2	-	4
Tpl Beckershov	2	-	2	4

Knowing road traffic flow

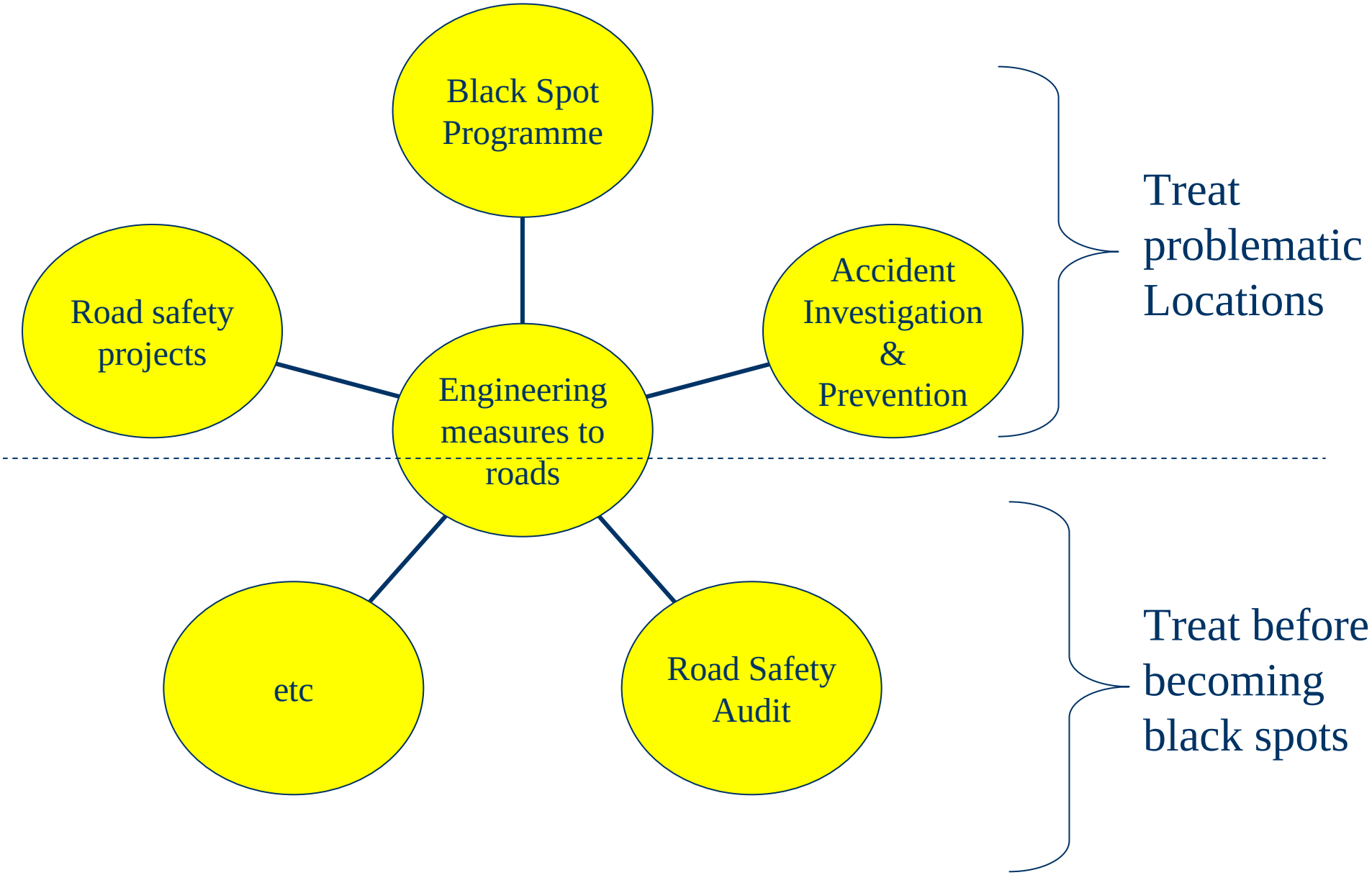


To insure a good traffic flow depending on junction and road type and to understand the probability of a serious or fatal accident to occur in relation to traffic volume.

Setting up the right countermeasures



Engineering measures



History “On The Spot” Research



History and RSA Development

- Developed by road safety engineers (early 1980's) in UK in response to serious and fatal accidents on new road schemes.
- In 1990, UK Safety Audit guidelines introduced
- In 1996, UK Safety Audit guidelines were revised.
- RSA is now carried out in many countries such as: UK, USA, New Zeeland, Australia, Canada, Sweden, Malaysia, Singapore.

What is Road Safety Audits?

A Road Safety Audit (RSA) is an effective tool, which brings traffic safety knowledge into the road planning and design process on new roads (future roads) with the purpose of **preventing** traffic accidents. It is carried out by an independent team of trained specialists to ensure a high level of safety for all road users under all types of conditions (e.g. weather, time).

Road Safety Audits Review

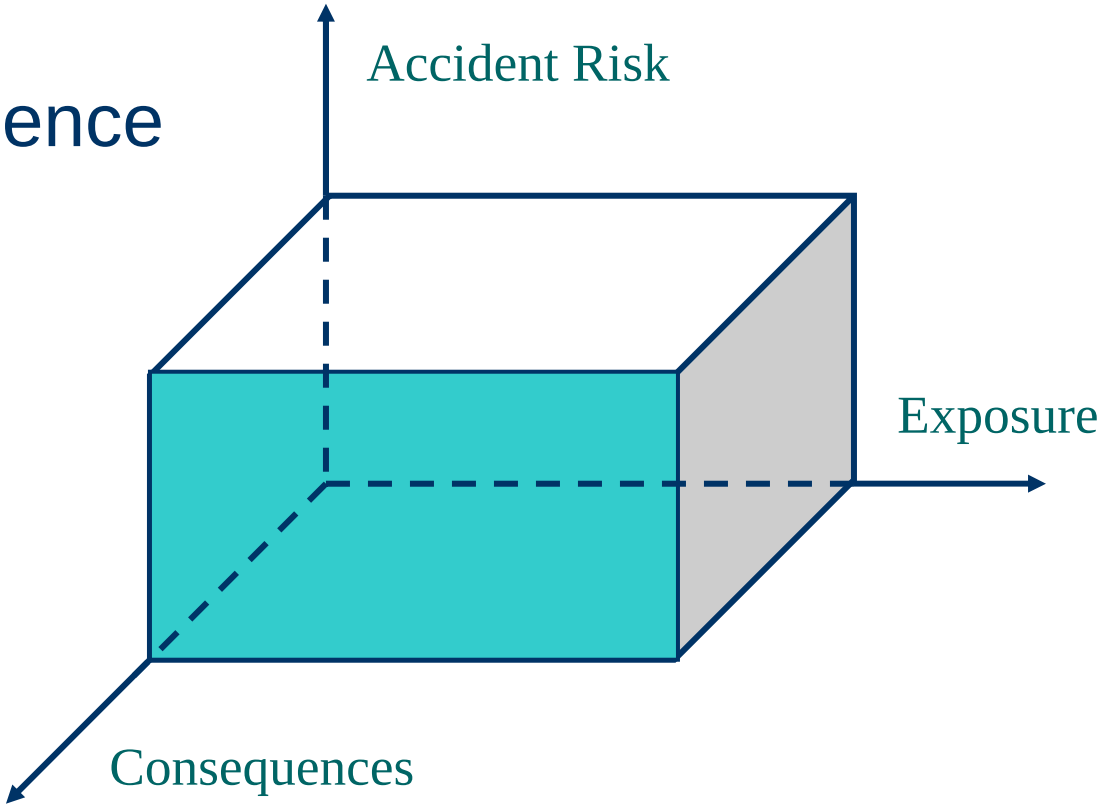
Road Safety Audit Review (RSAR) is conducted during the design process or existing roads to **reduce** number of accidents. The RSAR is more informal and flexible, which provides more opportunities for communication and interaction between the design team and the road safety team.

RSA vs RSAR

RSA	RSAR
Proactive (acting in advance to point out safety problems from the beginning and to reduce post-construction remedial work.	**Active**
Crash Prevention (better)	**Crash Reduction**
More time	**Less time**
Changes to drawings	**Changes to the site**

RSA and Risk elements

RSA & RSAR are developed to minimise the risks for the road users. Risk is a function of probability, consequence and exposure.



Road Safety Audit Requirements

- To all new main roads and highways.
- Hazard locations previously identified as being the worst 10% for accidents injuries.
- Smaller projects are only audited at later stages.

RSA Team Requirements

- A road safety audit team should has sufficient experience and knowledge in the areas of road safety engineering, road construction works, crash investigation and prevention, traffic management, and traffic engineering. It might also include police officers.
- The size of team depend on size and character of the scheme (at least two people).
- Objective and subjective assessment.
- Based on safety principles.
- From the road users’ point of view.

Costs and Benefits of RSA (RSAR)

- The cost of conducting safety audits and reviews is approximately 5 to 10 percent of the design cost of a project (less than 0.5 percent of total cost of the project).
- Researches indicates that Road Safety Audits have resulted in a 2 to 6 percent reduction in injury collisions. Also the expenses of rebuilding ”black spots” can be avoided.

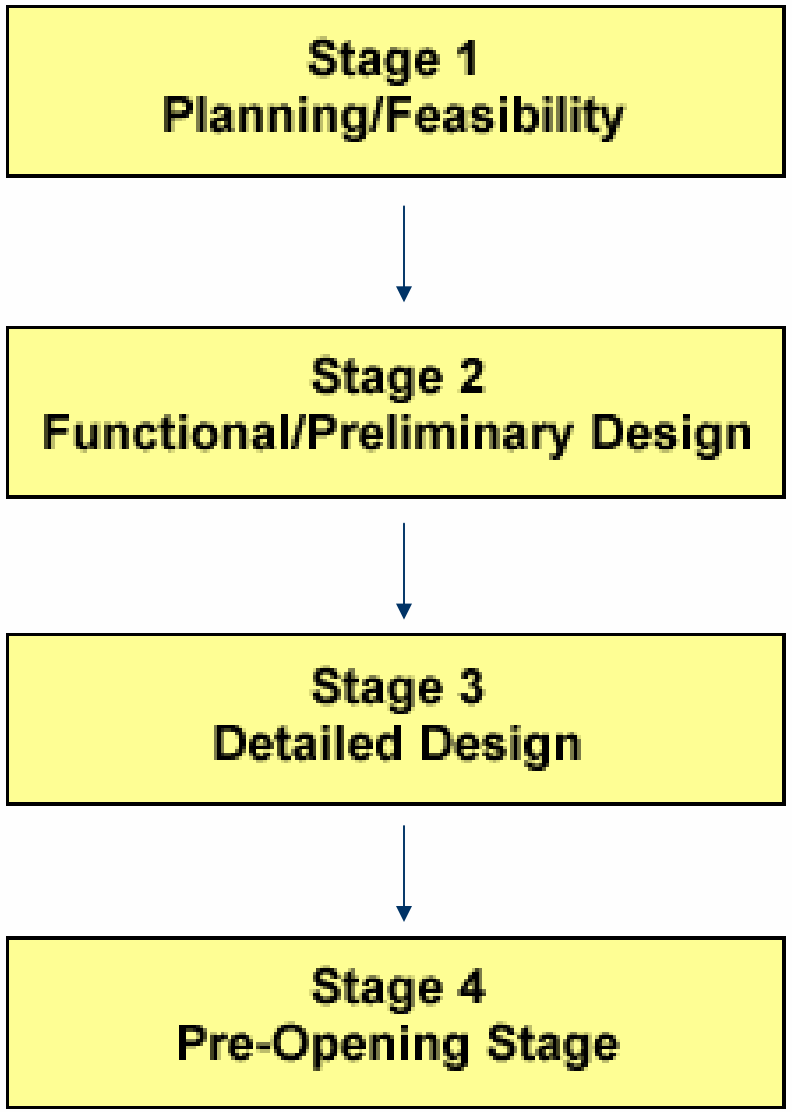
Audits Stages

* Different issues can be addressed at each stage.

* Stage 4 is essential as some aspects may be difficult from two-dimensional plan.

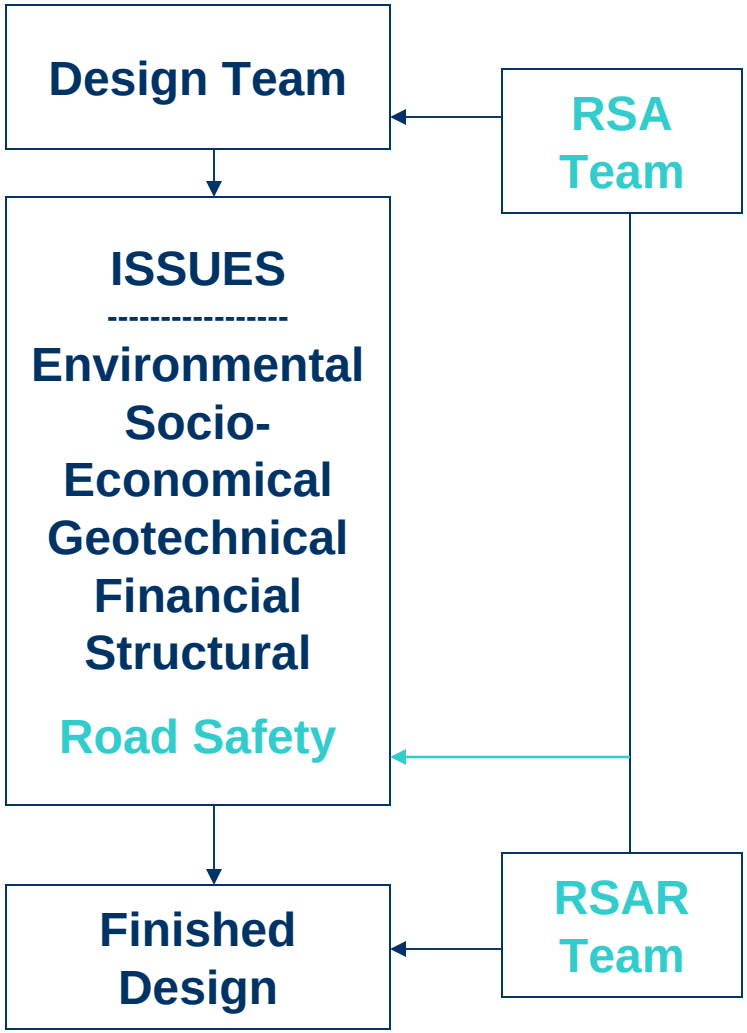
* Some authorities reduce number of stages depending on the scheme size, type and cost.

* There can be stage 5 on the existing roads.

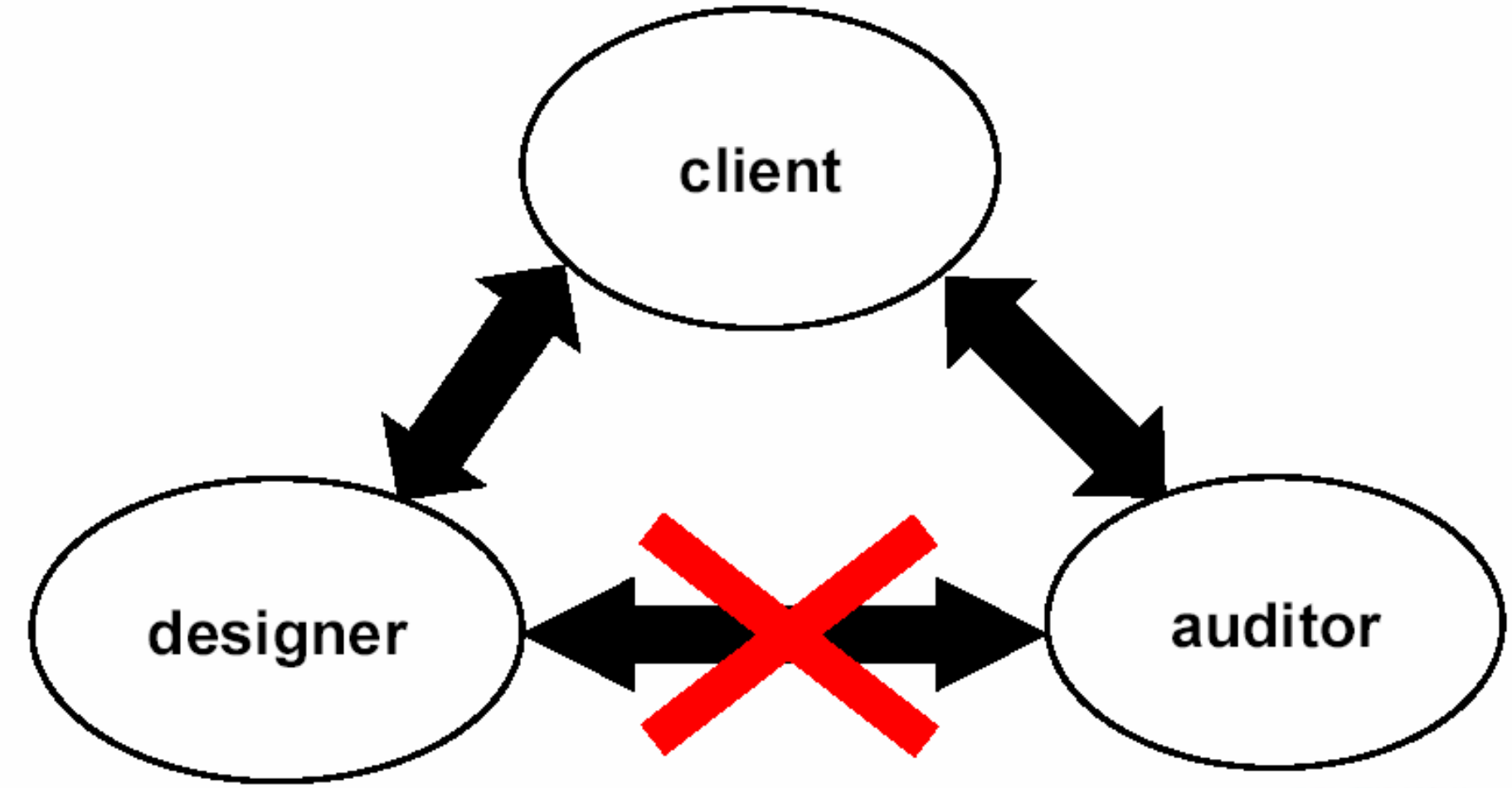


RSA vs Design Process

- Road safety component is usually missing in the design (or operation) process.
- The typical design should include RSA and RSAR.
- The role of design team is to receive the experts inputs (environmental, geotechnical, socio-economical, RSA, etc) and meeting as possible the project objectives.



Partners in the audit process



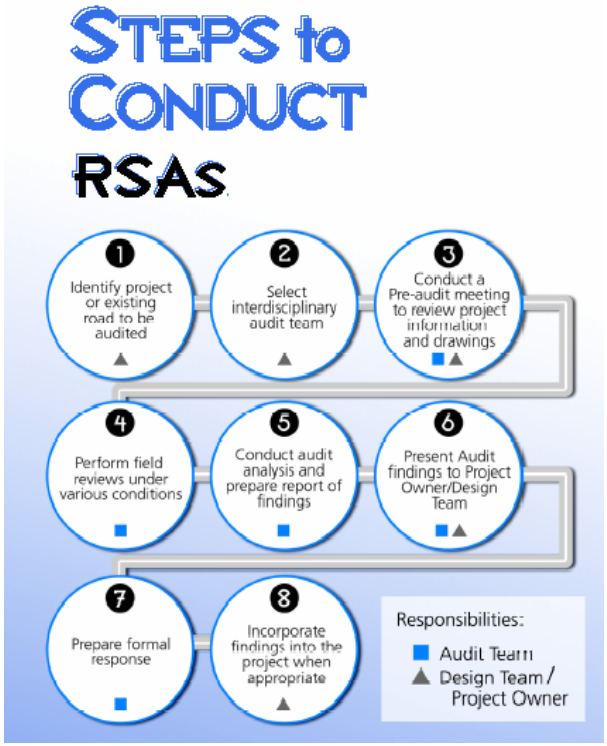
Steps to conduct RSA

Step 1: Identify project or existing road to be audited

Step 2: Select RSA Team

Step 3: Conduct a pre-audit meeting to review project information

Step 4: Perform field reviews under various conditions



Step 5: Conduct audit analysis and prepare report of findings

Step 6: Present RSA findings to Project Owner/Design Team

Step 7: Prepare formal response to the project owner and/or design team who they will response to each safety issue and why some suggestions could not be implemented.

Step 8: Incorporate findings into the whole project as appropriate

Audit Roles & Responsibilities



PROJECT OWNER

- express a committment to road safety
- provide funding and resources
- accept safety audits and reviews as an essential quality control requirement
- commission audits and reviews at appropriate times
- select safety team
- facilitate the response to the recommendations of audits and reviews
- attend start-up and completion meetings



DESIGN TEAM

- attend start-up and completion meetings
- provide relevant information to Safety Team
- act upon and document response to recommendations of audit



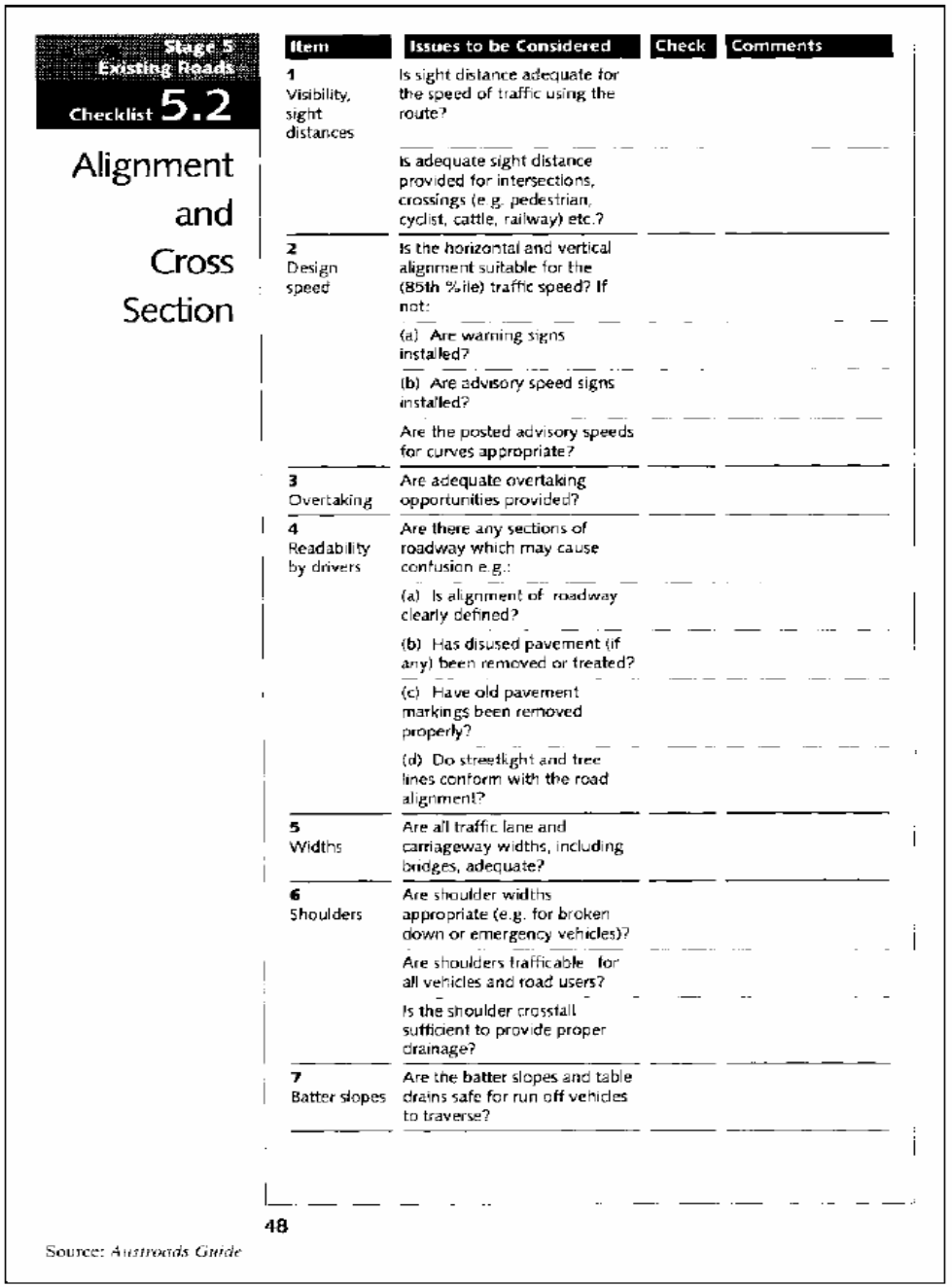
SAFETY TEAM

- identify safety issues in the proposed design
- make constructive recommendations to enhance safety
- document safety issues and recommendations
- hold completion meeting with Project Owner and Design Team

Source: http://www.roadsafetyaudit.com/

RSA Checklist

- Poor signs and signals visibility
- Poor bus stop location
- Missing pedestrian facili
- Poor lightening
- Pavement defects, marking
- Sight and stopping distances
- Etc..



Stage 5 Existing Roads

Checklist 5.2

Alignment and Cross Section

Item	Issues to be Considered	Check	Comments
1 Visibility, sight distances	Is sight distance adequate for the speed of traffic using the route?		
	Is adequate sight distance provided for intersections, crossings (e.g. pedestrian, cyclist, cattle, railway) etc.?		
2 Design speed	Is the horizontal and vertical alignment suitable for the (85th %ile) traffic speed? If not:		
	(a) Are warning signs installed?		
	(b) Are advisory speed signs installed?		
	Are the posted advisory speeds for curves appropriate?		
3 Overtaking	Are adequate overtaking opportunities provided?		
4 Readability by drivers	Are there any sections of roadway which may cause confusion e.g.:		
	(a) Is alignment of roadway clearly defined?		
	(b) Has disused pavement (if any) been removed or treated?		
	(c) Have old pavement markings been removed properly?		
	(d) Do streetlight and tree lines conform with the road alignment?		
5 Widths	Are all traffic lane and carriageway widths, including bridges, adequate?		
6 Shoulders	Are shoulder widths appropriate (e.g. for broken down or emergency vehicles)?		
	Are shoulders trafficable for all vehicles and road users?		
	Is the shoulder crossfall sufficient to provide proper drainage?		
7 Batter slopes	Are the batter slopes and table drains safe for run off vehicles to traverse?		

48

Source: *Austroads Guide*

FIGURE 1 Partial checklist for Stage 5 audit: Existing roads (*2*).

Success Factors

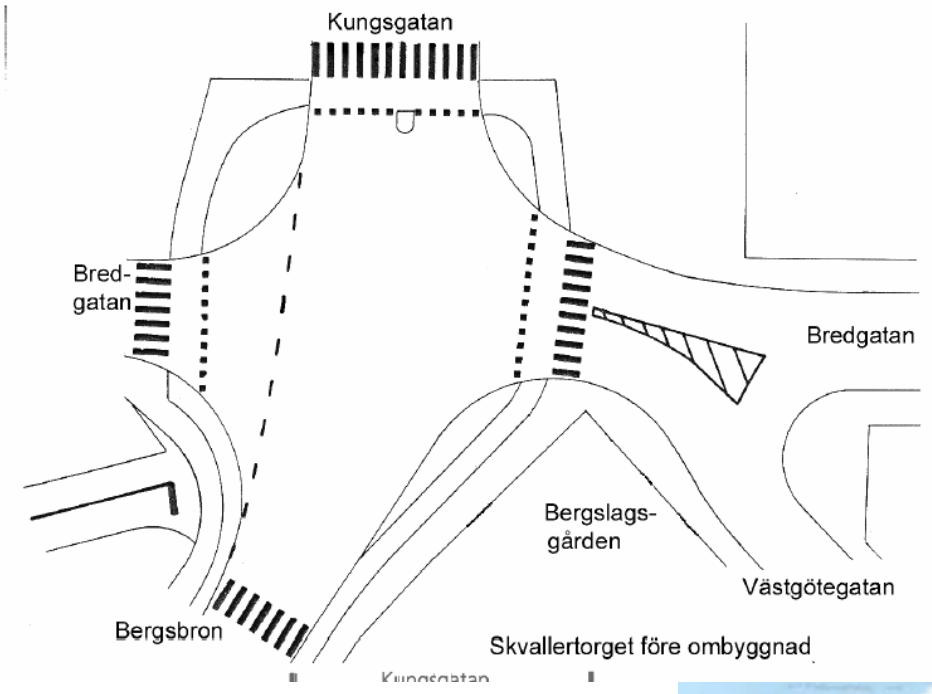
- Keeps to road safety issues and principles
- Well-described safety problems
- **Practical** recommendations
- Indication of priorities

Failure Factors

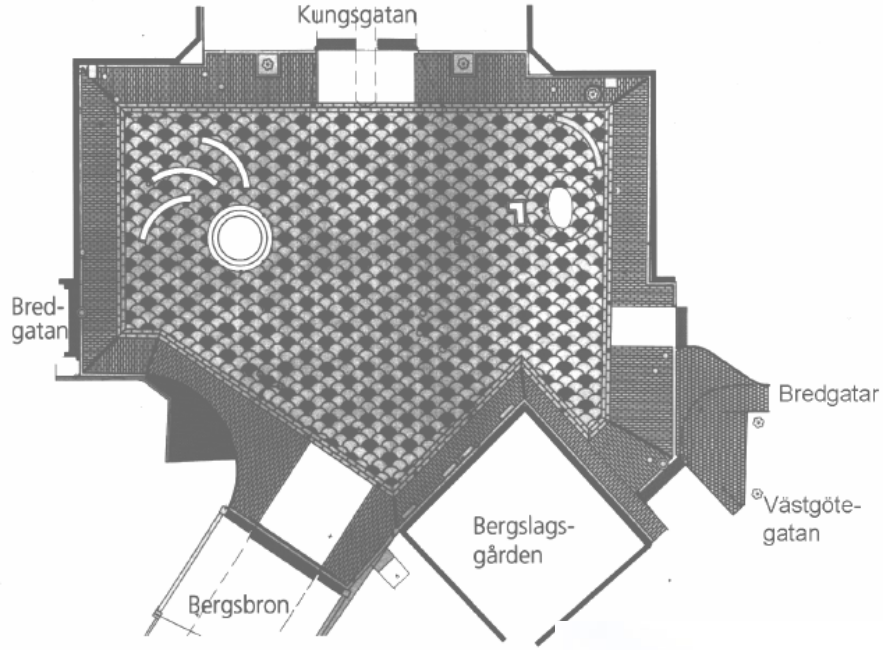
- Using the checklist blindly without any consideration of local situations.
- Too much emphasis on design features rather than real safety issues
- Unclear recommendations
- No indication of priorities
- Not based on published safety principles.

Examples of RSA items

Photos are used here for educational purposes only


Kungsgatan
Bred-
gatan
Bredgatan
Bergslags-
gården
Västgötegatan
Bergsbron
Skvallertorget före ombyggnad




Kungsgatan
Bred-
gatan
Bredgatar
Västgöte-
gatan
Bergslags-
gården
Bergsbron
Skvaller




MY FAIR LADY
JCDecaux


Magnus
Wernbloms
granne
0660 - 537 00
Den som vet mest
vinner mest
ODDSET
113 Ringdansen
(Kvarnberget)
SCANIA
max
30
km/tim
EOH 385






SXS 980

Safe cyclist network



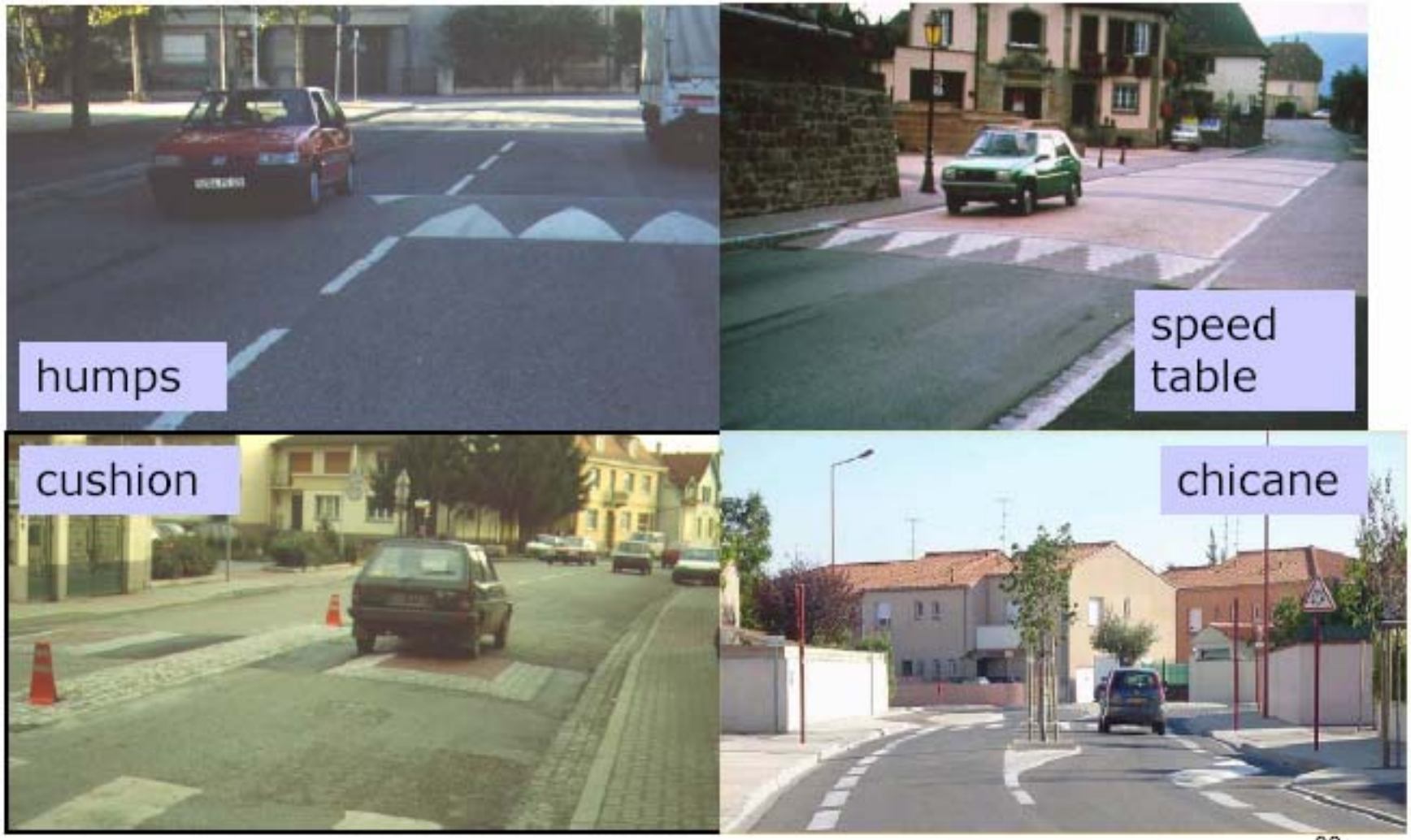
before

after



h.treve (CERTU)

Speed traffic calming
Engineering measures
A priority to vulnerable users







Crash cushion saves more lives @ hard gore area





h.treve (CERTU)



Ref 2


Misleading sign – incorrectly sited
Ref 2



Control boxes sited on the pedestrian desire line…




"fish-tail" ends can lead to
"spearing"

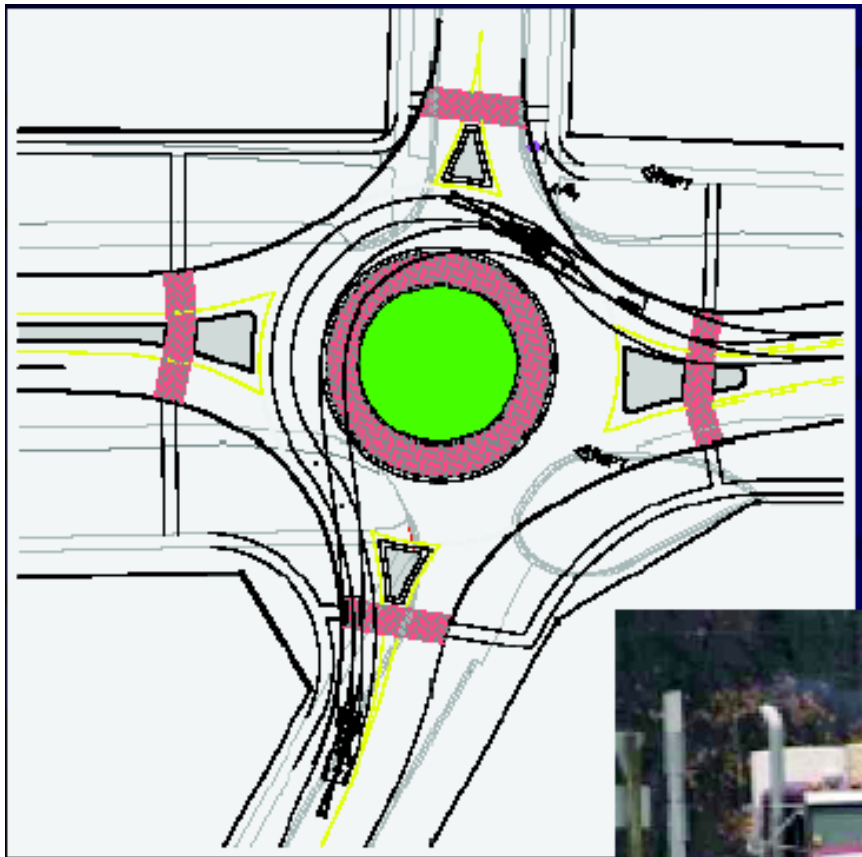


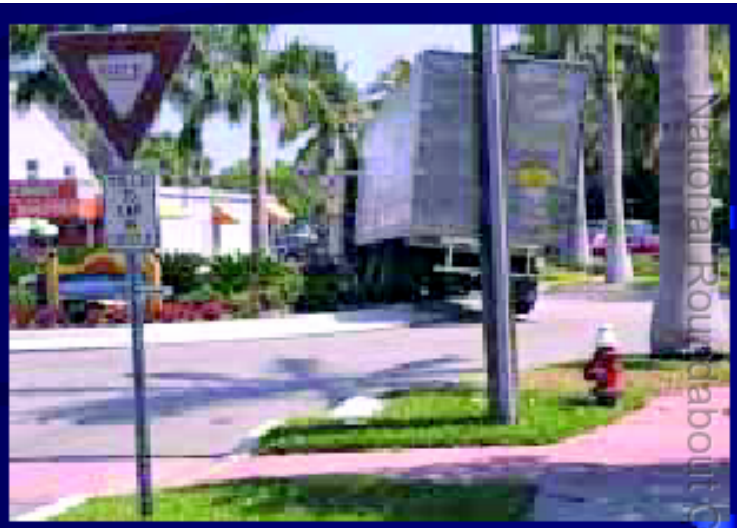
Safety Audit comment: cyclists at risk in cycle lane from reversing vehicles


Potential problem of pedestrians
masked from oncoming traffic…


But here, without RSA, pedestrians are encouraged to cross motorways, at great personal risk.....

Failure to Accommodate Large Vehicles
National Roundabout







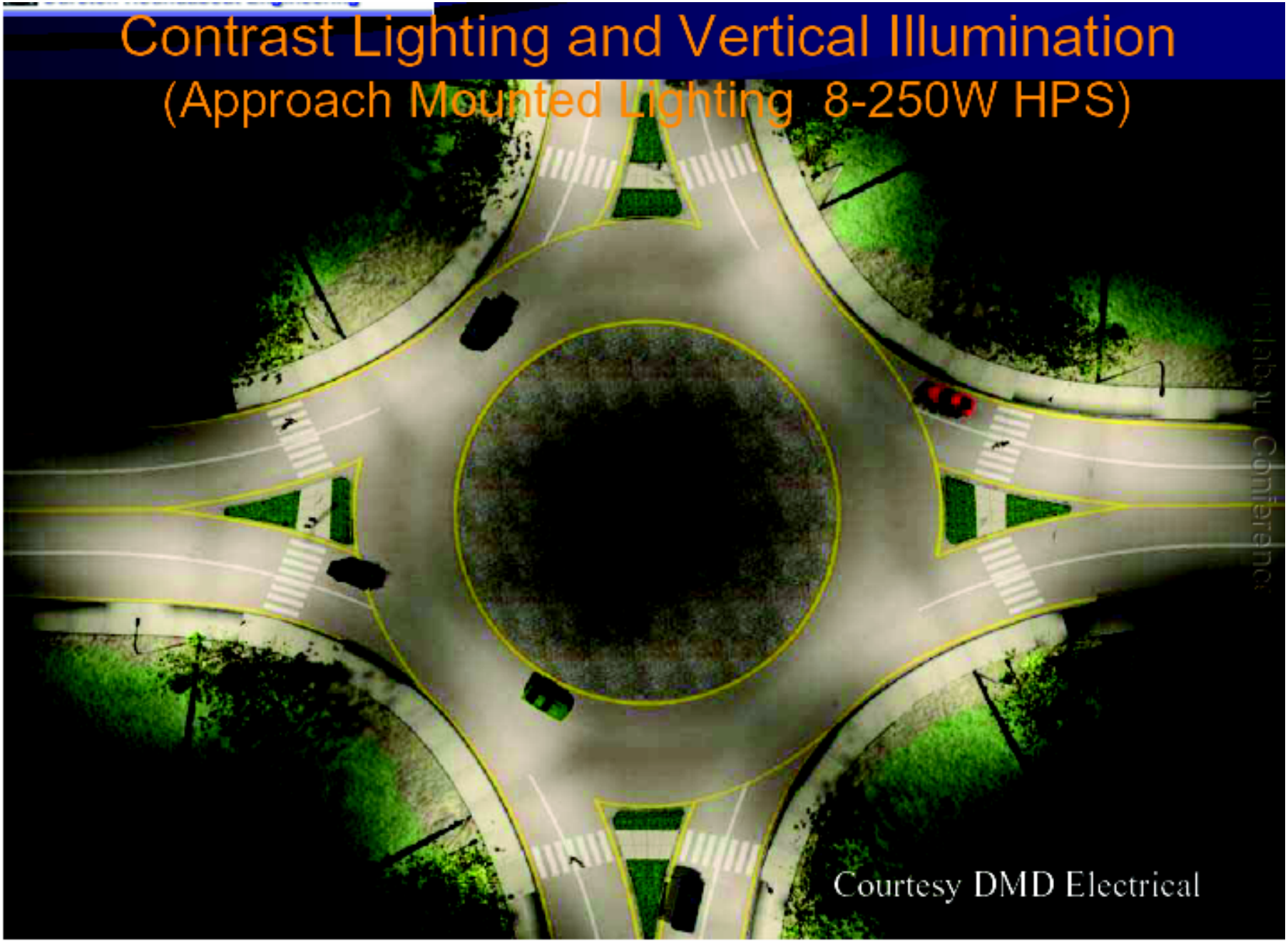
National Roundabout Conference 2005 DRAFT

Cross Walk Location



Contrast Lighting and Vertical Illumination

(Approach Mounted Lighting 8-250W HPS)



Unprotected trees and street furniture



Road surface defects





Directional sign is partially non obvious



No shielding

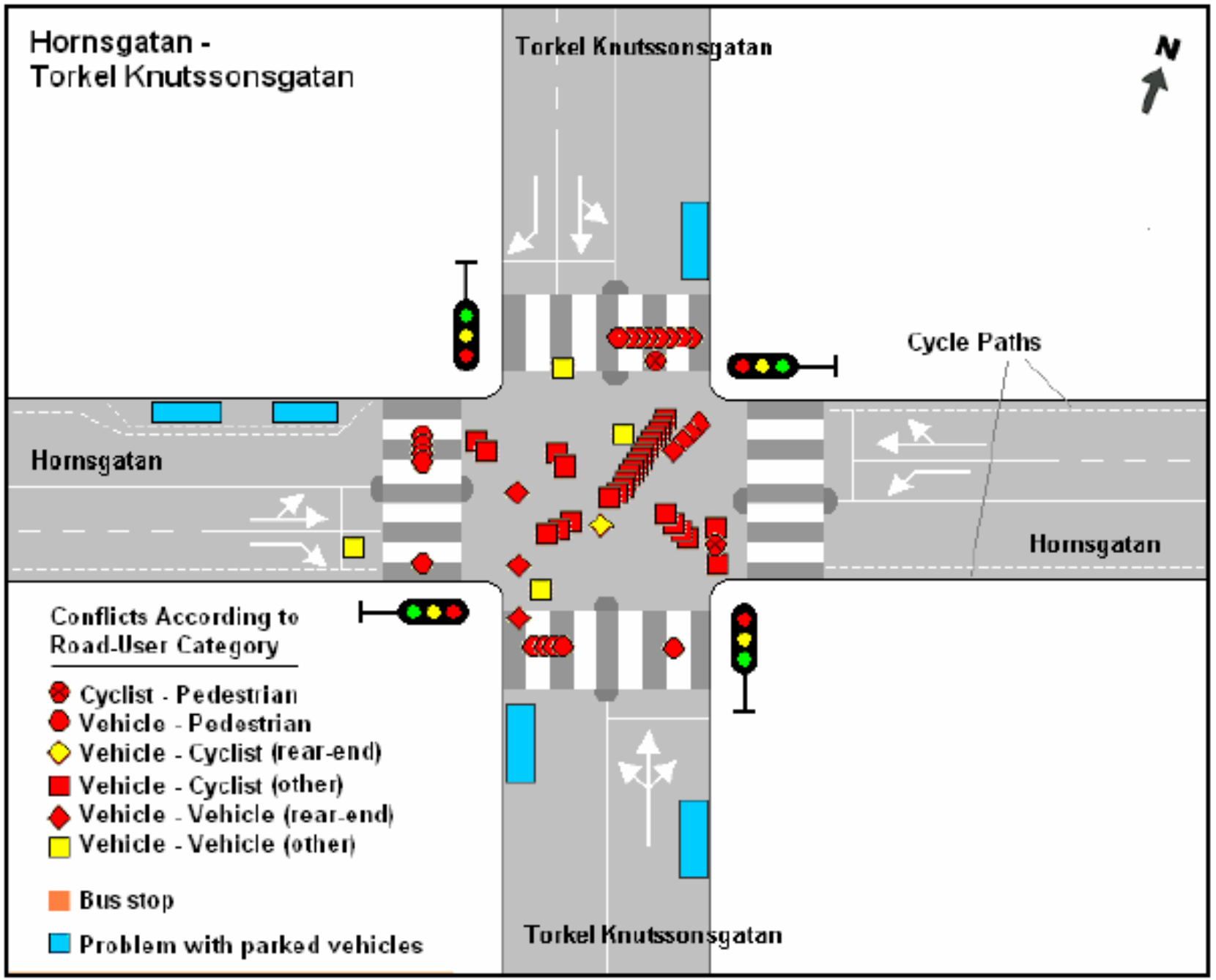


A mini-roundabout is one safety form of junction control.

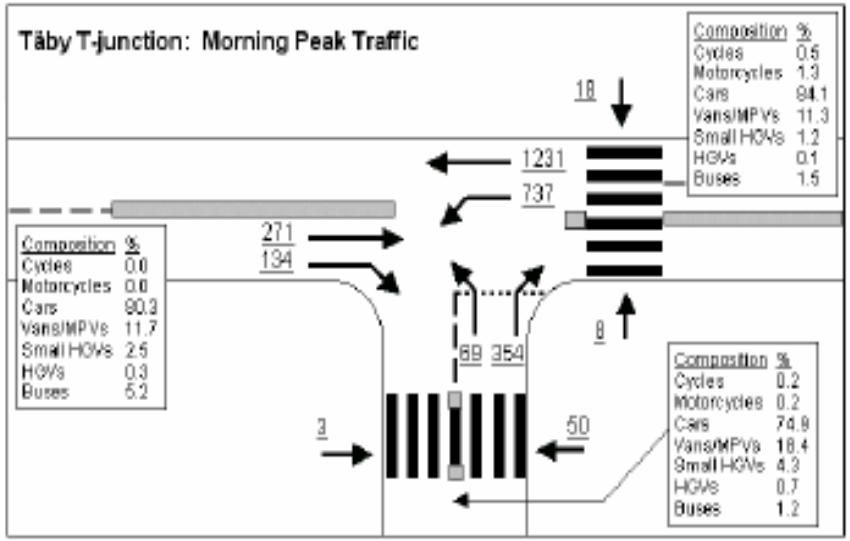


Varying pavement colours in this intersection (pedestrian crossing). *Source: FHWA-USA.*

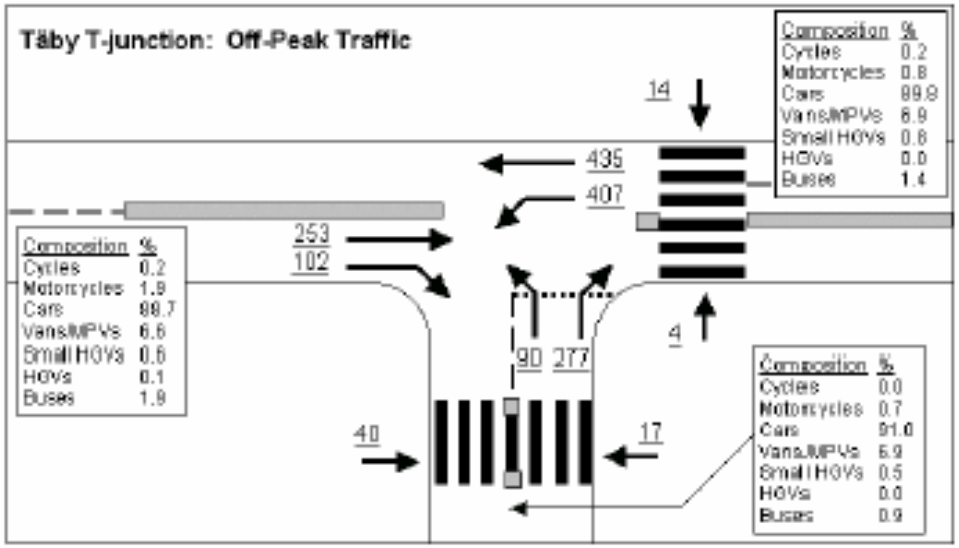



Hornsgatan -
Torkel Knutssonsgatan
Torkel Knutssonsgatan
N
Cycle Paths
Hornsgatan
Hornsgatan
Torkel Knutssonsgatan
Conflicts According to
Road-User Category
Cyclist - Pedestrian
Vehicle - Pedestrian
Vehicle - Cyclist (rear-end)
Vehicle - Cyclist (other)
Vehicle - Vehicle (rear-end)
Vehicle - Vehicle (other)
Bus stop
Problem with parked vehicles

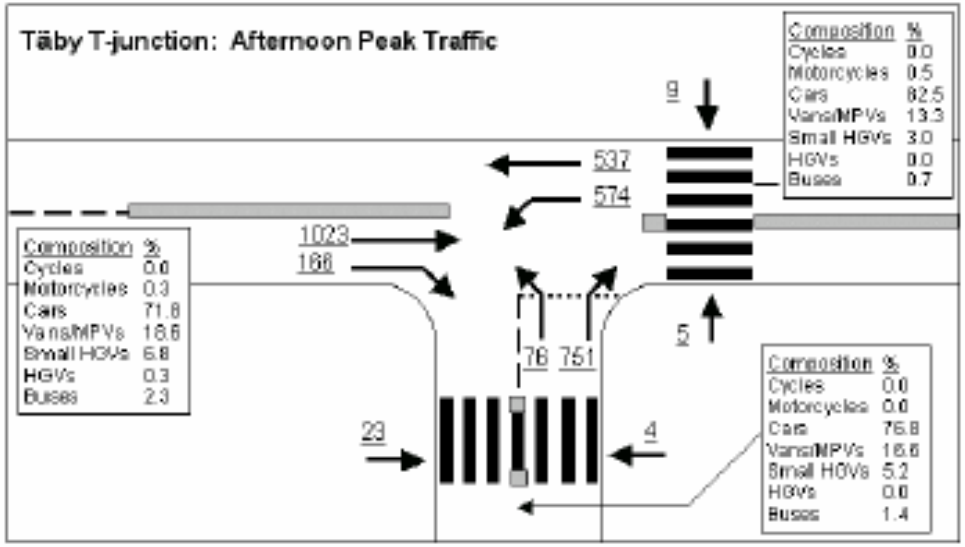
(a).


Täby T-junction: Morning Peak Traffic
18
1231
737
271
134
8
69
354
3
50
Composition %
Cycles 0.5
Motorcycles 1.3
Cars 84.1
Vans/MPVs 11.3
Small HGVs 1.2
HGVs 0.1
Buses 1.5
Composition %
Cycles 0.0
Motorcycles 0.0
Cars 80.3
Vans/MPVs 11.7
Small HGVs 2.5
HGVs 0.3
Buses 5.2
Composition %
Cycles 0.2
Motorcycles 0.2
Cars 74.9
Vans/MPVs 18.4
Small HGVs 4.3
HGVs 0.7
Buses 1.2

(b).


Täby T-junction: Off-Peak Traffic
14
435
407
253
102
4
90
277
40
17
Composition %
Cycles 0.2
Motorcycles 0.8
Cars 89.9
Vans/MPVs 6.9
Small HGVs 0.8
HGVs 0.0
Buses 1.4
Composition %
Cycles 0.2
Motorcycles 1.9
Cars 88.7
Vans/MPVs 6.6
Small HGVs 0.6
HGVs 0.1
Buses 1.9
Composition %
Cycles 0.0
Motorcycles 0.7
Cars 91.0
Vans/MPVs 5.9
Small HGVs 0.5
HGVs 0.0
Buses 0.9

(c).

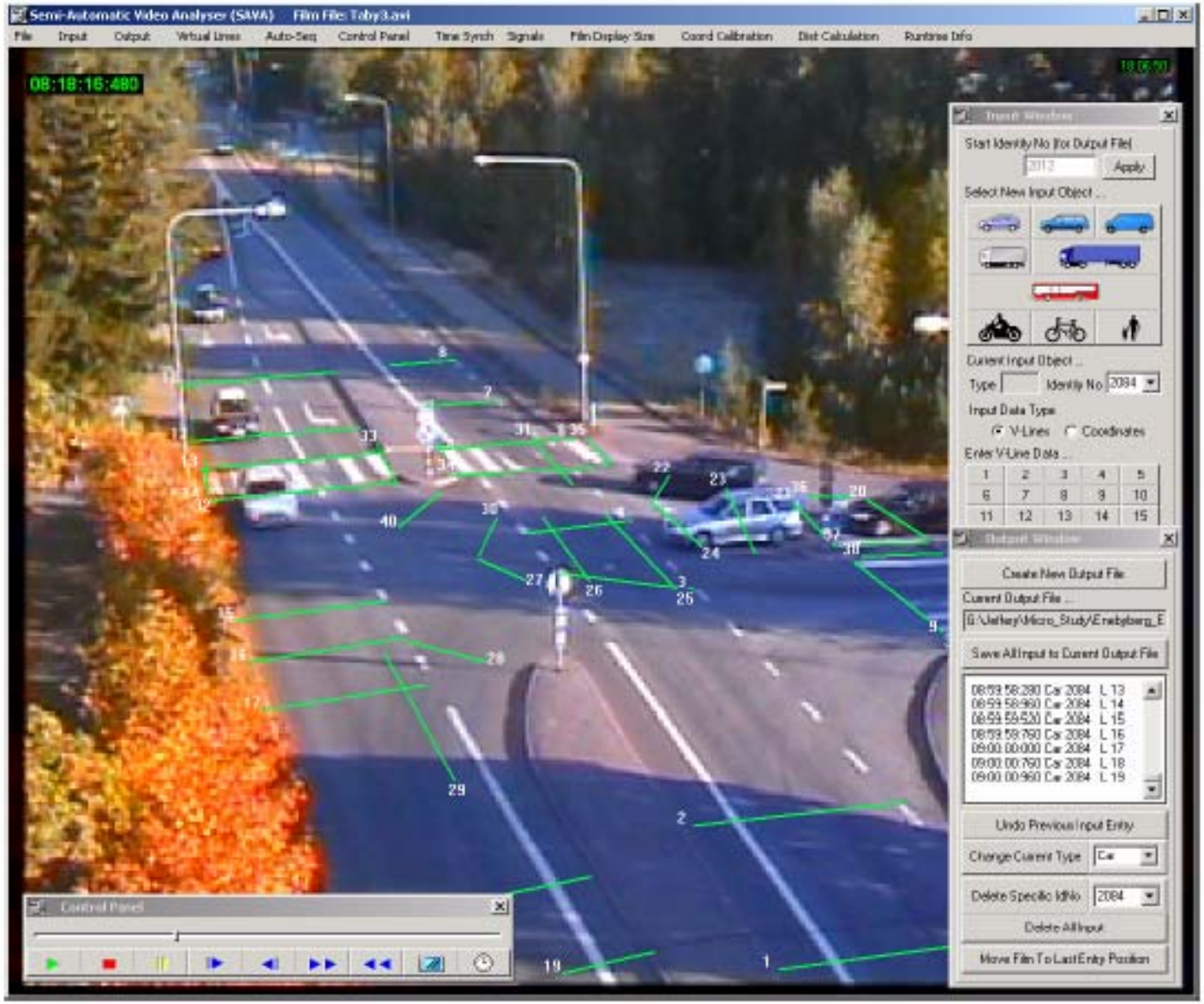

Täby T-junction: Afternoon Peak Traffic
9
537
574
1023
166
5
76
751
23
4
Composition %
Cycles 0.0
Motorcycles 0.5
Cars 82.5
Vans/MPVs 13.3
Small HGVs 3.0
HGVs 0.0
Buses 0.7
Composition %
Cycles 0.0
Motorcycles 0.3
Cars 71.8
Vans/MPVs 18.6
Small HGVs 6.8
HGVs 0.3
Buses 2.3
Composition %
Cycles 0.0
Motorcycles 0.0
Cars 76.8
Vans/MPVs 16.6
Small HGVs 5.2
HGVs 0.0
Buses 1.4

Virtual road safety audits
New concept and Multi-viewpoints





Video analysis (SAVA) software
The T-junction site in the Täby suburb



PBL 1:

- Project 1
- Groups?
- Road traffic accidents in Norrköping city,
- Road traffic flow in Norrköping city
- Photos of selected traffic and locations of roads in Norrköping City taken by students and discussed in classroom.
- Good and bad practices from different countries