Speed Management in Urban Areas

A framework for the planning and evaluation process

Report no. 168
1999

DUMAS

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Preface

The present report forms a description of a general framework for planning, implementing and evaluating speed management programs in urban areas.

The report is aimed at road authorities, at both European, national, regional and local level. This includes technicians, traffic planners, policy-makers and politicians.

Included in the speed management framework, is a description of the work throughout the process from collecting and mapping data, setting targets, forming a speed management strategy, designing the program, involving the public, and implementing and evaluating the program. The description is done partly in the form of a simple diagram illustrating a possible course of a speed management process, and partly through description of the main stages and activities indicated in the diagram. The descriptions contain good ideas, advice, checklists and examples within the referred topic.

As a whole, this report should enable the reader to start using speed management as an urban safety management measure.

Chapter 1 gives a short introduction to the speed management framework. This chapter is an independent chapter and can be read exclusively. Chapter 2-8 are more technical minded and describe in more detail the individual subjects in the framework.

The work presented is prepared within workpackage 5 in the DUMAS-project, Developing Urban Management and Safety. DUMAS is partly funded by the research programme of the Directorate General for Transport of the European Union.

The overall objective of DUMAS is to consider current practices of Urban Safety Management, and to produce frameworks for the design and evaluation of cost-effective and successful urban safety initiatives.

Three institutions, the Danish Road Directorate from Denmark, the Transport Research Laboratory from the United Kingdom and SWOV Institute for Road Safety Research from the Netherlands have contributed in preparing workpackage 5.

Besides this report, the output from DUMAS workpackage 5 includes a report on speed management practice and experiences in Denmark, the Netherlands and in the United Kingdom, see the reference list.

Content

1 Introduction

What is Speed Management?

Speed management is basically about regulating the car speed by use of various methods, e.g. legislation, road layout measures, enforcement, campaigns or advanced technology.

Speed management is not necessarily about reducing speed, but to a considerable extent about planning and designing the road layout and the road network in such a way that an appropriate speed is obtained.

One of the key elements in speed management planning is the road and speed classification (the preparation of a road hierarchy), where roads in the network are classified or designated to an appropriate desired speed level, e.g. 30 km/h in residential areas or 60 km/h on major arterial roads.

Speed management techniques can therefore be applied to all kinds of urban roads, right from residential roads (where the techniques are widely used today) to arterial roads, distributor roads or through roads.

One of the most common speed management tools is known as 'Traffic Calming'. 'Traffic Calming' has mainly been used in local areas in order to reduce the speed or the traffic flow. This can be done via various speed management techniques, e.g. road design, visual effects, legislation, regulation or signing and marking.

Why Speed Management as an Urban Safety Measure?

It has been clearly shown by several studies that speed has a significant effect on road safety. Examples show that only minor changes in speed can lead to quite large reductions in the number of road accidents and injuries.

For example, studies based on observation of urban roads indicates that there is a 3-6% reduction in the number of accidents for each 1.6 km/h (1 mph) reduction in vehicle speed, /1/, /2/. Not only the number of accidents but especially the severity of the injuries is highly correlated with speed, particularly for vulnerable road users. Whereas 85% of pedestrians die from being hit by a vehicle travelling 64 km/h, only 5% die from being hit by a vehicle travelling 32 km/h, /3/. It has also been indicated in

literature that the variation in speed between vehicles within the traffic stream is associated with accident occurrence.

Changes in speed do not only affect safety but also other parameters as perceived risk, barrier effects and traffic noise are strongly related to high-speed levels. Speed is also an important factor when talking about quality of life in cities, aesthetics, preservation of historical sites and other environmental aspects.

Experiences gained throughout Europe show good safety effects from different kinds of speed management schemes. By use of traffic calming solutions, the observed safety effect ranges from 15-80%, /3/. Not only speed management schemes in residential areas have resulted in improved safety but also schemes implemented on distributor roads or through roads have shown safety effects in the area of 45-65%, /5/.

It has been estimated that a reduction of the average speed by 5 km/h on the entire EU road network would decrease the annual number of fatalities in the EU by more than 11,000 and the number of injury accidents by approximately 180,000. The savings are estimated at 30-40 billion ECU annually, /3/.

Travel time is obviously closely related to speed, and it has been claimed by some that the benefits of speed management programs could not compensate for private and social time losses due to lowered speed levels. However, it has been proven that the extra travel time needed on speed management treated through roads is minimal. Also, the average travel time in area-wide speed management treated towns is not necessarily higher than elsewhere.

In other words, when talking about Urban Safety Management, one cannot ignore that one of the key issues is Speed Management. Managing the speed on urban roads is of crucial importance in order to create a safe and secure road network, and to ensure a pleasant environment for road users and people in general.

A framework for Speed Management Programs

A general framework for a speed management program is illustrated in Figure 1. The figure outlines the main activities in the framework: The State of the transport system, Targets, Strategy, Activities, Implementation and Evaluation.

The activity process is to some degree indicated in succession. However, it should not necessarily be followed blindly, but rather used as a guideline. And depending on the actual speed management scheme or work already done, one or more of the activities can be left out.

As it appears in the figure, the activity *Involving the Public* is indicated in the middle of the process. However, this does not imply that the activity should be considered only at this stage.

Each of the activities of the speed management process is described in a general form in the following chapters. The chapters contain good ideas, advice, checklists and examples within the referred topic, but should be adapted and carried through in accordance with national and local planning conditions and traffic culture.

In Annex 1 an expanded version of the diagram in Figure 1 can be found (unfold). This diagram includes a brief summary of each of the activities in the speed management process.

Figure 1 The Speed Management Process
(A detailed version can be found in Annex 1)

As a starting point in the process, a statement on safety problems, traffic data and the transport system as a whole must be done. In this step, it will be determined what the problems are and their causes and their underlying contributing factors. More information on this subject can be found in chapter 2.

The identification of targets will clarify the objectives and help point out responsibilities for all actors involved. Furthermore, targets will make the established policy measurable and can form a basis for the evaluation process. See Chapter 3.

In the stage of formulating the speed management strategy, questions on economy, time plans, policies, cost/benefit, use of different speed management techniques are taken into account, see Chapter 4.

Subsequent to the strategy formulation, activities concerning road and speed classification (road hierarchy), public involvement, design of speed management techniques have to be described. A description on these activities can be found in chapter 5-7.

A final vital step in the process is to carry out an evaluation program. In this stage, it must be determined whether or not the set target has been reached, and if not, why? The evaluation program should as a minimum include evaluations on safety, speed, traffic flow, etc. See chapter 8.

2 State of the Transport System

Why?

In order to get a picture of the current traffic and safety situation, a collection of relevant *road*, *accident*, *traffic*, *surrounding*, and *opinion* data, and a subsequent processing and mapping of these data has to be done. The data is a precondition for any planning process including a speed management program.

From the mapping of data it is possible to determine the extent of problems, and to identify the most important issues in the specific area.

Mapping of the relevant parameters also makes it possible to make a pre-evaluation of various measures related to the local targets, and to prove conclusively to the politicians and the public that speed management in fact is needed to attack the most relevant problems.

Finally, it forms a foundation on which to assess the actual trends of traffic and environment-related problems, and a premise for a sufficiently good evaluation of the actual speed management scheme.

How?

Depending on the size and the type of speed management scheme the following data can be collected and analysed:

- Road network data (existing road function, network for vulnerable road users, and network for public transport)
- Accidents (3-5 year period, if possible divided into personal injury, damage only accidents, severity, accident types)
- Traffic flows (AADT of motor vehicles, cyclists/mopeds, trucks, and pedestrians)
- Speed (posted speed limits, average speed, speed profiles, travel speeds)
- Security and barrier effect concerning vulnerable road users
- Environmental and visual parameters (emissions, road noise, air quality, aesthetics)
- Public transport (bus services)
- Road user behaviour
- Public attitude and opinion
- City plan functions (residential areas, schools, shopping centres, industry)

The collected data must be mapped in a clear and understandable way, so that the main conclusion is apparent for all involved, also non-experts.

Methods to collect/measure data, see Chapter 8 , Table 1.

CHECKLIST

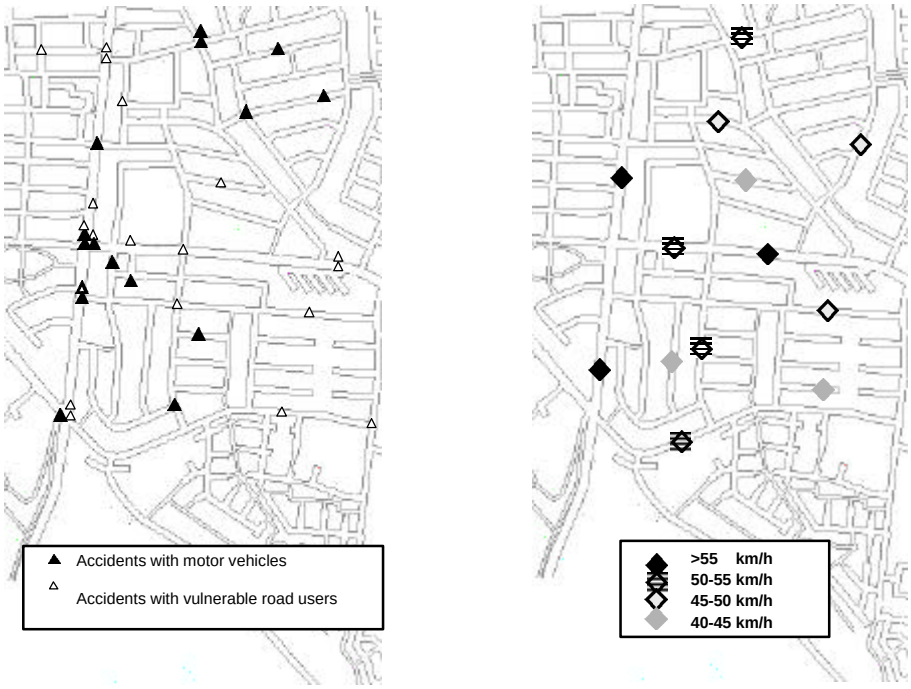
Collecting data

- Collect only data which are relevant to the actual speed management scheme
- As a minimum, data on accidents, traffic flows and speed should be collected
- Use surveys, interviews, questionnaires, etc. to collect issues concerning security, travel patterns, and traffic attitudes
- Study issues which are considered important by citizens or local politicians. (see Chapter 7, Involving the Public)

Mapping data

- Describe the existing function of the road, including identification of road users
- Map accidents and point out sites having safety problems
- Identify specific accident types, e.g. accidents related to alcohol, accidents with vulnerable road users, etc.
- Compare local accident trends to national figures
- Map other data collected
- Do on-site inspections of the road network
- Carry out supplementary measurements if needed
- Prepare a summarising map of the road network, showing sites with safety problems, speed levels, security problems, etc.

Examples



Examples of maps illustrating police recorded accidents in a 5 year period and speed measurements.

3 Setting Targets

Why?

The setting of targets for the definite speed management scheme results in an improved scheme and an improved utilisation of limited resources to road safety and environment planning in general. Clear and specific targets give a greater understanding and clarity with regards to how the development should be steered, and thus the basis for drawing up a result-oriented strategy for action is established.

In short, targets will:

- create clarity for all actors involved on goals to be reached,
- make the established policy measurable,
- make it possible to compare the present situation to the set targets and adjust the work accordingly (direct and control activities).

How?

There are various ways to define targets. Targets could either be qualitative (overall subjective targets as e.g. improved security) or quantitative (specific measurable targets as e.g. 5% reduction in speed).

Qualitative targets can be difficult to evaluate since they are to some extent based on subjective estimates, but can be used in pointing out the wanted direction for future developments.

Examples of qualitative targets are:

- Reduced motor vehicle speed
- Improved road user behaviour
- Improved facilities for vulnerable road users

Quantitative targets are specific measurable targets and are easier to assess, though, it is vital that the quantitative targets are measurable within a specific period of time. This makes it possible to evaluate the development from year to year, and adjust the efforts in relation to the set targets.

Examples of quantitative targets are:

- 5-10% reduction in average speed for motor vehicles on main urban roads
- A maximum level of speeders of 10% by the year 2005

- A maximum of 6% traffic flow of heavy vehicles
- 20% reduction in accidents involving vulnerable road users by the year 2003

CHECKLIST

- ❑ Targets should be set in harmony with results achieved through the processing/mapping of before data
- ❑ National targets (if any) should be the starting point when setting local targets. Add targets related to the speed management programme, adjusted to the local conditions
- ❑ Targets should be time limited e.g. a period of 3-10 years
- ❑ Targets should be realistic
- ❑ Use measurable targets, if possible
- ❑ Local politicians should take part in the setting of targets. Involvement of the public could also be considered, see Chapter 7.

4 Speed Management Strategy

Why?

The formulation of a strategy should lay down overall decisions or settings on economy, time plans, and traffic policies, and include considerations about efforts, speed management measures and actors involved. The strategy should facilitate managing the process and make clear for everybody involved how the future work is handled.

How?

On the basis of the mapping and the set targets, an overall unified description of the following work is drawn up.

Involving the police and the public in the description can be advantageous, see Chapter 7. The final strategy/policy though, should be adapted or accepted by the local politicians. Remember that the starting point for any strategy formulation is the set targets and the state of the transport system. Road Safety Audit should be considered in the design process.

CHECKLIST

- Decide which road(s)/area(s) should be treated
- Does the data collection and mapping point out specific problems which need special attention?
- Which efforts should be chosen in proportion to the set targets and financial circumstances (overall priority)?
- Should any road user groups be highlighted in relation to the priority?
- Draw up a budget plan.
- Consider possible measures as regards road design, police enforcement, campaigns, education and information
- As a part of the strategy, work out a detailed activity plan and time schedule concerning planning, design, implementation, measurements for the purpose of evaluation, and involvement of the press, the public, etc. – see the example below.
- In relation to the time planning, completion of road safety audit should be taken into account

What is Road Safety Audit?

Road safety audit is a review of road schemes from a traffic safety point of view, before the schemes are carried out in the field.

To ensure that the planned speed management scheme will function as safely as possible, a Road Safety Audit could be beneficial. The basis for the audit is the application of safety principles to new scheme designs, to prevent accidents occurring or to reduce their severity. The road safety audit requires an objective approach to the assessment of accident-risk through an independent checking of schemes unconnected with the original design, but with experience and expertise in road safety engineering and accident prevention. Road safety audit is carried out at specific stages during the course of the scheme, from the planning stage to the opening stage.

☞ Road Safety Audit Manuals are available in Denmark and the United Kingdom.

Example

The activity plan describes in more detail the subsequent work and efforts which are required to carry through the actual speed management programme, and to fulfil the set targets. In the example below, the activity plan demonstrates at which activities various actors should be involved (x), and when the activities should be carried out.

Activity Plan

	Actors Involved				Time (months)													
	Technicians	Politicians	Public	Police														
Activity					1	2	3	4	5	6	7	8	9	10	11	12	13	14
Road and Speed Classification	x			x														
Decision on Speed Management Techniques	x	x	x	x														
Draft Design	x	x	x	x														
Priority of Projects	x	x	(x)															
Detailed Design	x			(x)														
Road Safety Audit	x																	
Implementation	x																	
Evaluation	x		x	x														
Information																		

5 Road and Speed Classification

Why?

It is the road classification (classification of a road hierarchy) which forms the basis of a speed management planning process. Together with the mapping of data, the road and speed classification, makes it practicable to produce a plan of the area concerned.

By designing or adapting the various roads and paths in the urban network, conflicts between different functions of the road system can be reduced. The designing/adapting should be done in such a way that mutual and incompatible functions are, as far as is practicable, separated onto different roads, and the network as a whole provides safety and convenience for the desired mixture of uses. The mixture and balance of functions to be performed by each road need to be identified, so that it can be designed or adapted accordingly.

To avoid the minor roads considered for local traffic are used for through going traffic and to ensure that drivers on all types of road classes adjust their speed to the situation and the road function, the road network need to be classified for speed, as well.

How?

According to the identified/desired function of each road, the road network is classified into a specified number of road classes. When evaluating which class a road belongs to, a number of criteria have to be considered.

Examples of criteria which could be considered when classifying a road

- The present function of the road, including traffic flows
- Whether the buildings on the road have road frontage
- Whether shops or other generating functions are facing the road
- The number of vulnerable road users
- The number of residential properties along the road
- The capacity and width of the road
- Whether the road is wide enough to establish bicycle facilities

For each road class one or more specified speed intervals are set. The speed is determined in consideration of safety, perceived risk, accessibility, town plans, etc.

Examples of criteria which should be considered when classifying for speed:

- The defined road class
- The present and the future traffic flow of vehicles, bicycles, pedestrians, and bus traffic along and/or across the road
- Existing and possible construction of bicycle tracks and/or footpaths (separation of motor vehicles and vulnerable road users)
- The present and future need and ease of crossing the road (concerns especially cyclists and pedestrians)
- Existing or future establishment of central reservation
- The traffic control of junctions
- Whether the buildings have road frontage or there are road exits
- The ribbon development
- The present or future establishment of speed reducing measures
- The function of the road in other respects (shopping street, housing access road, etc.)
- The visibility conditions
- The geometry of the road (e.g. road alignment and profile)

CHECKLIST

- ❑ Specify a suitable number of road and speed classes (must match each other to some extent)
- ❑ Identify the desired function of the roads in the network
- ❑ Compare this to the mapping of the road, accident, traffic flows, through going traffic, speed, city plans and surrounding parameters
- ❑ Classify the road network into a number of road classes. High-class roads must form a coherent road network. Local residential areas delimited by high-class roads should have an appropriate size
- ❑ Specify the desired speed class for the road network
- ❑ Map the road and speed classification

The proposed road hierarchy could be consulted with the politicians, police, the local inhabitants and/or the affected road users.

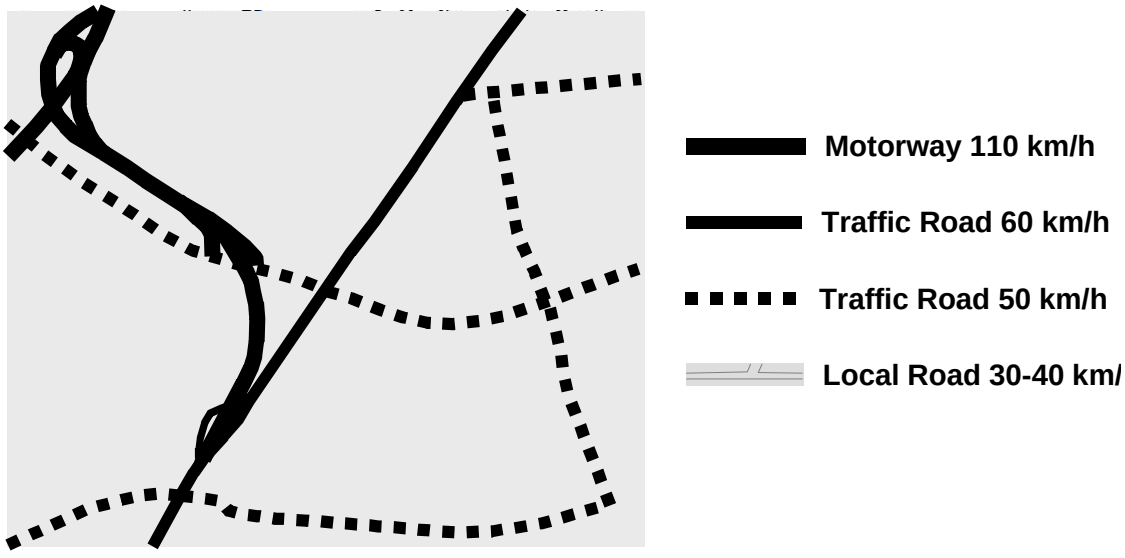
Example

Road and Speed Classification Systems have been developed in Denmark, United Kingdom and the Netherlands as integrated parts of national guidelines for planning and designing of urban roads. A more detailed description can be found in /9/, /12/, /13/. As an instance of a road and speed classification system, below the Danish is roughly illustrated. It has two road classes and a number of speed classes. Table 1 indicates a few basic and simplified road lay out recommendations for each road and speed class.

Road class	Speed class	Examples of road characteristic
Traffic Road Major roads serving through going traffic and traffic between urban areas.	90-110 km/h	Motorway, highway. VRU not allowed, no parking.
	60-70 km/h	VRU separated from motor traffic, VRU crossings only at grade separated or signalised junctions, parking not allowed on carriageway, limited access, no speed reducers, 2-6 lanes, lane width 3,5m
	50 km/h	VRU separated from motor traffic, crossing facilities needed for VRU, medium access, no angle or perpendicular parking, 2-4 lanes, lane width 3.00-3.25m
	30-40 km/h	cyclists mixed with motor traffic, pedestrians separated, high degree of access, no angle or perpendicular parking, 1-2 lanes, lane width 2.75-3.00m
Local Road Minor road serving only local traffic in e.g. residential areas.	30-40 km/h	cyclist mixed with motor traffic, pedestrians separated, high degree of access, 1-2 lanes, lane width 2.75-3.00m
	10-20 km/h	VRU mixed with motor traffic, 'shared' areas, motor traffic must give way, 1-2 lanes, lane width 2.75m

Table 1 *Simplified example of the Danish road and speed classification system. (VRU abbreviation of Vulnerable Road User)*

The figure below shows how the system can be used in an urban area. N.B: this example includes motorways, though these are not typical for urban areas.



6 Speed Management Techniques

Why?

If roads included in the speed management programme has been classified to a desired speed level, which is lower than the existing one, various speed management techniques can be used to ensure the desired speed level.

If converse, a road has been classified to a higher speed level than the existing one, it must be ensured that the road layout and the network design is capable in handling the traffic in a safe and secure way for all types of road users.

Even if a road has already a speed level near the chosen desired speed, it might be required to redesign some of the stretches, to impose a physical and visual speed reduction on the motor traffic.

A reason for redesigning roads is that speed limit signs stating the allowed or recommended maximum speed have proven to be insufficient in most cases. Furthermore, it is considered psychologically more meaningful and generally beneficial to achieving an appropriate traffic flow, if the road design and the stipulated speed appears clearly to the car drivers.

> ☞ The road design and the stipulated speed should appear clearly to the car drivers.

It must be kept in mind that various speed management techniques can be applied in the speed management programme, and an overall decision of where to use, and what kind of techniques to use, must be made.

How?

The decision of where, and what kind of techniques to use must match the speed management strategy, the outcome from the data collection and mapping, the time schedule, and economic factors.

Below is a brief description of the main types of speed management techniques that can be found. For each technique, different categories within the main types are listed.

- Road layout measures
- Road network design
- Campaigns and information
- Enforcement

CHECKLIST

- ❑ Consider speed management techniques within the main types: Road layout, network design, police enforcement and campaigns/information
- ❑ Decide where and when to use which technique, and take into account the strategy, results of the mapping, economy and time schedule
- ❑ If possible, combine two or more of the techniques
- ❑ Consider involvement of affected residents, road users, and the police, see Chapter 7
- ❑ Indicate on a map the measures, which should be applied to the individual roads
- ❑ Consider road safety audit, see Chapter 4

Road layout measures and network design

In a case where rebuilding road stretches or junctions is definitely required, the scheme often consists in a combination of different types of road layout measures and network design. Preparation of alternative solutions with various effects and costs will often be appropriate, as the politicians have the option to decide how many resources the local authority should apply in proportion to the expected effect.

When designing the road network, it should be done according to the road and speed classification and considerations on the following issues must be taken into account.

- Length of road links
- Junctions types
- Distance between junctions
- Parking facilities
- Road closure
- Road access

In parallel with the road network design, various road layout measures can be used. The most common road layout measures are listed below:

- Sign posting (mandatory signs, speed limit zone signs, recommended speed signs)

- Road narrowing (narrowing from road side/centre, narrowing to one lane, staggering/chicanes, cycle tracks/lanes, plantings)
- Surface treatment (humps, raised areas, rumple strips, change in road surface)
- Point of entry (gates, plantings, rumple strips, changes in road surface)
- Junctions (raised areas, roundabouts, signals)

The road layout measures should be adapted to:

- The desired speed level
- The number of accidents
- Vulnerable road users (crossings, security and barrier problems)
- Schools and shopping functions
- Other road functions
- Bus services
- Traffic flows
- Road geometry

Speed campaigns and information

Speed campaigns and information programs are carried out with the aim of raising the public awareness about risk and speed and/or with the aim of introducing different kinds of speed management schemes, for instance in relation to major changes in road layout or installation of new technology (e.g. speed camera control).

> ☞ Speed campaigns must be combined with control efforts, such as police enforcement, with technical measures and, just as important, with involvement of local inhabitants.

Below are mentioned different types of methods used to communicate the message of a campaign/information programme.

- Material delivered to households (stickers, badges, leaflets, reflective tags, etc.)
- Road side posters
- Local TV/radio spots
- Local press
- Schools, household associations

> ☞ A long-term, repeated, professional, systematic, simple and goal–directed approach is necessary, otherwise road users simply do not get the message. Use key-facts and key messages.

Police enforcement

With advantage, speed campaigns can be followed up with speed controls. Though enforcement of traffic regulations does not usually enjoy the same level of public support as other enforcement activities. Public opinion can nevertheless be influenced by sustained and targeted media campaigns concerning the risk associated with speed.

> ☞ The publicity explaining the risk associated with drinking and driving has shown an effect on how the public perceives such behaviour.

The main categories of police enforcement measures are:

- Speed camera control (mobile, stationary)
- Manual control

The manual controlling can for instance be directed towards specific road users, e.g. heavy vehicles, or at selected places, e.g. near schools and school routes.

> ☞ Experience shows that campaigns alone do not have any great effects

7 Involving the Public

Why?

There are good reasons for involving the public in planning and implementation of speed management schemes, and in relation to urban traffic management in general.

Firstly, speed management strategies - and transportation strategies in general - increasingly require changes in attitudes and behaviour of road users if the strategies are to succeed in their objectives. The more a scheme is supported by the people affected, the more likely will the implementation of the scheme be successful.

Secondly, traffic engineers or transportation planners working for a local authority are unlikely to be familiar with any particular area as well as the local people who use it regularly. Besides being aware of the problems in the area, the local inhabitants and/or road users possibly also can have positive ideas of the kind of measures which might be appropriate in the particular situation.

> ☞ Understanding, and acceptance by the local public is of major importance for the success of the scheme.

Furthermore, in the case of financial constraints, schemes are more likely to be adopted if there is evidence of strong local support

Finally, it is important, not only for the particular project but also for the public's attitude toward traffic reorganisation in general that the public is involved in the planning.

How?

There are several ways to involve the public in a speed management process. These range from simply sharing information on decisions already made by the road authority, to public participation in the decision process.

Broadly speaking, three levels of public involvement can be identified:

- *Information*: Essentially a "one-way process" in which information about implementation of the relevant scheme/measures is disseminated from an authority to the public via local newspapers, TV, radio, information pamphlets etc. Information of this kind extends to the widest possible target audience, among others reaching many people who have no interest in the scheme.

- *Consultation*: A "one-way process with feedback", where the views of the public is sought at various stages of the speed management process as input to the process which remains under the control of the relevant professionals. Consultation usually involves use of leaflets, exhibitions (meetings/public hearings) or questionnaires. Consultations are mainly targeted at particular groups (e.g. the road users or residents in the particular speed management area)

- *Participation*: A "two-way dialogue" between the professionals and the public, and where the public has direct influence on the outcome of the process. Participation involves potentially far fewer people than the case with information and consultation.

In general, the higher the level of public involvement in the process, the greater are time and other resources required during the process. Though, as mentioned above, the effort is often well worth it later in the process in terms of increased knowledge about local traffic problems, and increased acceptance and greater support from the public.

Who are the public and which tasks can they deal with?

The 'public' includes all people who have an interest in the development and implementation of the speed management programme, but excludes the team of local authority professionals and any consultants charged with the task of preparing the programme. In the broadest sense, the public comprise those who are the users of the affected network (in relation to both passenger and freight movement), and those who live, work, shop, etc. in the area concerned.

Examples of groups of people to be considered in the 'public involvement' are:

- House owners' association
- Local chambers of commerce
- The local road safety council
- School boards
- The police
- Bus service companies
- Emergency services
- Groups of handicapped people

- Environmental action groups
- Local cyclists' Association
- Private companies

Involving the public can include the following tasks:

- Mapping of perceived problems concerning e.g. security, safety problems, etc.
- Discussion and assessing of collected data on accident, speed, etc.
- Discussion of results
- Proposals of solutions and priority of these
- As a part of the evaluation process, the effects from the speed management program can be discussed

Though politicians usually make the final decision and prioritise the measures, suggestions proposed by the public, can influence the final decision.

CHECKLIST

- ❑ Determine in *which phases* of the speed management process the public should be involved
- ❑ Decide in *what level* the public should be involved at each stage of the process: On an information level, consultation level, or participation level
- ❑ Determine *who* should be involved

8 Evaluation

Why?

An evaluation of the consequences of a speed management scheme should, in principle, always be carried out. There are two main reasons for evaluating. Firstly, for the sake of the project itself, it must be ascertained whether or not the changes fulfilled the underlying intentions so that any errors can be rectified. Secondly, for the sake of future schemes, such studies increase a municipality's (and other actors') general knowledge of the consequences of individual initiatives.

How?

To facilitate an evaluation of a speed management scheme, it is vital to specify measurable success criteria for all the targets and results of the project. In the actual evaluation, the continuous monitoring of the criteria and the overall measurement of the situation before and after the implementation of the scheme should be described in detail.

It is important to determine whether the evaluation should assume the form of a quantitative analysis in which large quantities of data are collected and analysed statistically, or a qualitative analysis, with in-depth studies of many parameters, but based on a smaller data collection – or a combination of the two types.

> ☞ The overall design of the evaluation should be determined at a stage before the implementation, thus lacking pre-data can be collected, if necessary.

The particular speed management scheme, including any speed campaigns, should as a minimum be evaluated in relation to the number of accidents, average speeds, and traffic flows. However, depending on the scheme size and the measures which form part of the scheme, additional parameters can be compared before and after the completion of the project. It generally applies, that the larger and more innovative a scheme, the more parameters should be evaluated.

Below are examples of different parameters to measure safety, speed, environmental conditions and public opinion. Ideas of how to collect/measure different parameters can be found at the end of this chapter in Table 2.

CHECKLIST

- ❑ Decide which parameters should be measured (number of accidents, average speeds, and traffic flows – as a minimum)
- ❑ Determine the evaluation form: e.g. a statistical analysis or an in-depth analysis
- ❑ Involve the public in order to evaluate public opinion, security, etc.
- ❑ Compare measurements from the initial situation and the after situation – calculate the effect
- ❑ Compare the results with the set 'success criteria' and set targets
- ❑ Pass-on relevant evaluation results to relevant people: e.g. the actors involved, road authorities, politicians, professionals, road users and citizens
- ❑ Evaluate the particular speed management process

Parameters to evaluate safety

- Police recorded accidents/injuries
- Hospital recorded accidents/injuries
- Accident rates (accidents/million vehicle kilometre) or -frequency (accidents/year)
- Security, perceived risk and barrier effect
- Changes in speed
- Road user behaviour

The effect on accidents should be measured 3-5 years after the completion of the scheme. Comparing the number of accidents during two equally long time periods, i.e. 3-5 years before and 3-5 years after completion of the scheme could accomplish this. The observed accidents could either be "damage only" accidents, "personal injury" accidents or the observed number of killed and injured. The key problem is often to obtain a reasonably large data set in order to measure any statistical effects in accident reductions.

In cases where the traffic volume has changed fundamentally, comparisons of accident rates before and after the reconstruction could be made.

Decreases in speed or improved road user behaviour are secondary safety parameters which could be used in situations where the number of accidents in the before period is very limited or non-existent.

Traffic migrations onto the surrounding (alternative) roads are sometimes the consequence of a speed management scheme. A survey concerning accident migration onto these roads should therefore be considered.

Parameters to evaluate speed

- Speed levels at a given site/spot (average speed, 85th percentile)
- Speed profiles (measured by use of car following)
- Travel speed
- Percentages exceeding the speed limits

When registering how *speeds* are influenced by the reconstruction, it is important that the before- and after-measurements are carried out at the same point on the road, and 'before' measures are placed correctly in relation to the (planned) speed reducing measures. In order to get a true picture of the speed level, the measurements ought to be taken *between* the individual speed reducing measures.

Furthermore, the before/after measurements, as much as possible should be carried out under similar conditions (month, day, time, weather etc.).

Parameters to evaluate traffic flow

Automatic and manual traffic counts can be used to estimate the flow of:

- Motor vehicle traffic
- Number of vulnerable road users

When counting, distinction should be made between different sorts of motor vehicles: cars, motor cycles, light goods vehicles, other goods vehicles, buses and coaches.

Automatic counting apparatus can with advantage be used to measure motor vehicle traffic, and in some cases bicyclists. Pedestrian movements can best be measured by manual counts.

Since traffic flows vary throughout the day, month and year, it is important to ensure that the 'before' and 'after' traffic counts are done under similar conditions, or at least converted to equivalent annual average daily traffic (AADT) values.

When evaluating traffic flows, a survey dealing with traffic migration onto surrounding (alternative) roads should be considered.

Parameters to evaluate environmental parameters

When assessing the environmental impact of a specific speed management scheme, the following parameters could be considered:

- Emissions (HC, CO, CO_2, NO_x, particles)
- Air quality
- Road noise
- Aesthetics

Most of the parameters can be recorded, either as measurements or as calculated estimates. However, as it is costly and time-consuming to perform measurements, estimates can be used to a large extent. Prediction models can be used to estimate emissions, road noise and air quality.

Parameters to evaluate speed campaigns

Like an evaluation of safety and speed, an evaluation of a speed campaign is a quality control to help assess whether the measure (here the campaigns message) has influenced the target group's understanding of the problem, and the target group's behaviour. An impression of the effect of a speed campaign is achieved by registering the target group's behaviour not only after, but also before and during the campaign.

Three important issues are involved in evaluating campaigns:

- Has the target group seen and perceived the message?
  (is studied using questionnaires or by interviews)
- Has the target group's behaviour changed, and how? (For instance, has the speed decreased?)
- Has safety improved?

Especially the last issue can be difficult to measure since external conditions, e.g. road layout measures and increased police control, if any, can influence the accident number.

Table 2 below, illustrates methods to collect/measure various parameters.

Assessment Method		Safety					Traffic					Environmental			
							Speed			Flows (AADT)					
		Accidents	Injuries	Accident rate/freq.	Security	Barrier effect	Profiles	Travel	Average	Motor vehicles	Light road users	Emissions HC, CO, CO2, NOx	Air Quality	Aesthetics	Road noise
Observational		Police/(hospital) records			Video (behavioural studies)	Visual recording	"Following technique" (test car)	Test car, Number plate matching	Automatic & manual measurements: mobile aut. counting app., loops, radar, laserpistol, video, test car, number plate matching, manual counting (Inventory records)			COPERT data base (Eu records) Test car method	Air quality measurements	Systematic visual examination	Manual measurements
Estimates	Prediction models	Accident Prediction Models								Traffic models		Basis: traffic flows, speed, traffic composition, driving patterns, street geometry			Basis: traffic flows, speed, density (HV), street geometry, ground etc.
	Estimates			Basis: accidents, flows, road length (km)		Basis: flows, speed, road width, needs of crossing									
Public opinion	Postal questionnaires				Self-completion questionnaires, school routes survey					Route survey			Self-completition questionnaires		
	Interviews				Stop-interviews Home-interviews								Home interviews (Stop interviews)		
	Meetings				Public meetings Public hearings								Public meetings		

***Table 2**. Methods to collect/measure various parameters*

Closing the evaluation

After having collected the required and adequate after-data, a comparison between the initial- and the after-situation is possible. These results are subsequently compared with the set targets and the success criteria.

Results obtained throughout the evaluation should besides being communicated to relevant persons within the traffic domain, also be passed on to affected road users and citizens via local radio, papers, home delivered folders etc. The more information is shared with the public and other interested actors about the project and its results, the more the project will be accepted and similar projects allowed.

> ☞ Information to the public and other interested actors on successful results will increase the motivation for future schemes

Finally, the speed management process itself should be evaluated. Both conditions which succeeded as expected, and conditions, which did not, should be considered and explained. The explanations will be helpful to future programs.

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Annex 1

Speed Management Process

State of transport system

Collect and Map data on
- Accidents
- Speed
- Road network
- Traffic flows

Consider public participation in order to map perceived risk, security

Setting targets

Set targets for the Speed Management program
Should be set on the basis of national/local targets and the current status.
Can be formulated in greater detail during the process.

Involve local politicians

Strategy

Describe the Speed Management strategy
How can the targets be achieved ?
What kind of methods could be used ?
Where should the effort be aimed at ?
Does any specific road user group need special attention ?
Set up a rough estimate on economy and time plan.

Activities

Road and Speed classification
Classify the road network for:
- road type, road function (road hierarchy)
- speed class

Speed Management Techniques
Consider the main types:
- Road layout measures (humps, staggering, narrowing, etc)
- Network design
- Campaigns, information, education
- Police enforcement

Overall decision on, where to use measures, what kind of measures.
Take into account: Economy, Time plan, (Road Safety Audit).

Consider participation from:
- *Public / affected residents*
- *Politicians*
- *Police*

Draft design
Produce a first draft of the speed management scheme:
Draft drawings, rough estimates on costs, safety benefits
road safety audit.

Consider participation from:
- *Public / affected residents*
- *Politicians*
- *Police*

Involving the public
Can be arranged via:
- Information
- Hearings
- Meetings
- Working groups

Involve: House hold owners' association, local chambers of commerce, the local road safety council, school boards, groups of handicapped people, environmental action groups, local cyclists' association, etc.

Priority
Put the measures in order of priority on basis of
- cost/benefit
- economy
- time plan
- other issues

Make sure that the priority is accepted by local politicians.

Detailed design
Produce a detailed design of the Speed Management scheme.
Consider Road Safety Audit.

Make sure that all the needed 'before' data is available for the evaluation.

Implementation

Carry out the scheme
Make visual inspection before opening/start (Road Safety Audit).
Collect 'after' data for the evaluation, inform the public, press about the project.

Evaluation

Make evaluation, as a minimum on
- accidents
- speed
- traffic flows

Compare results with the set targets, success criteria.
Evaluate the process, what went wrong, what went well.
Communicate results to all actors involved, other road authorities, professionals, technical staff, etc.

Consider participation from
- *Public*
- *Police*