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INTEGRATED SPEED MANAGEMENT STRATEGIES IN LOCAL COMMUNITIES IN SOUTH EAST EUROPE

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Abstract: Local communities may have a key role in the improvement of road safety through the exploration of specific developments to promote safer roads and mobility as well as to improve road user behavior. Among others, such activities include the development of a speed management strategy. In EU speed is included among the three main risk factors on the roads. Moreover, speeding is a primary factor in about one third of fatal accidents and an aggravating factor in all accidents. A systematically applied integrated speed management strategy would certainly provide road safety benefits.

The objective of this research is to present the procedure for the development and the implementation of an integrated speed management strategy in South East Europe based on experience from several research projects carried out at NTUA (including the recent ROSEE project) and good practice and advice from the international literature adjusted for the specific needs of the South East Europe. All critical elements of such an integrated speed management strategy are analysed and discussed, with concrete proposals for the objectives, the action areas, the implementation modalities and the monitoring and evaluation of the strategy. It is concluded that the success and effectiveness of an integrated speed management strategy depends directly not only to strong political support but also to a systematic monitoring of road safety level and the continuous evaluation of the measures implementation.

Keywords: speed management strategy, road safety

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1. INTRODUCTION

In 2010, the European Transport Safety Council (ETSC), in its PIN Flash publication, included speed among the three main risk factors on the roads, the others being alcohol and seat belts. Although other parameters, such as roadside environment or traffic, may influence drivers' decisions and consequently their driving performance in terms of safety, excessive and inappropriate speed is recognised as a major road safety problem. Speeding was found to be a primary factor in about one third of fatal accidents and an aggravating factor in all accidents (ETSC, 2010). Generally, speeding is the number one road safety problem in a large number of OECD/ECMT countries (OECD/ECMT, 2006).

The procedure, which aims at delivering a balance between safety and efficiency on a road network, contributes in the reduction of excessive and inappropriate speeding and optimizes drivers' compliance with the posted speed, is known as speed management. In order for a speed management strategy to be effective, it is extremely important the proposed system-wide road safety interventions to be referenced to human tolerance in terms of injury, and thus the 'Safe System' approach (SWOV, 2006; SNRA, 2006) should be taken under consideration.

The objective of this paper is to present the procedure for the development and the implementation of an efficient integrated speed management strategy in South East Europe. More precisely, all critical elements of such an integrated speed management strategy are analysed, namely; objectives, action areas, implementation, as well as monitoring and evaluation.

For the achievement of this objective, experience from several research projects carried out at NTUA were exploited, together with the activities on speed management strategies of the ROSEE project (www.rosee-project.eu). Furthermore, good practice and advice from the international literature was incorporated and adjusted for the specific needs of the South East Europe.

Within the project "ROSEE - Road Safety in South East European Regions" of the South-East Europe Transnational Cooperation Programme, the problem of speeding was examined as one of the primary risk factors throughout South East Europe. Efforts to tackle this problem took various forms such as the enhancement of road safety professionals' knowledge on speed management, informational and awareness raising activities and the development of a transnational speed management strategy based on the two-year multi-component speed management strategies developed for a specific region in each partner country of ROSEE (Štaba and Možina, 2014). In Greece, the speed management strategy was developed specifically for the area of Peloponnese (Yannis & Laiou, 2014).

However, before developing a speed management strategy, certain requirements need to be addressed as described below.

Initially a key step is to define the stakeholders involved with speed management concerning the selected road network, and their responsibility areas in terms of jurisdiction, design, construction, maintenance, and operation. It is also very important to identify the authority/ies in charge of setting speed limits throughout the assessed road network. This step will allow the most appropriate distribution of roles and tasks within the strategy and the identification of potential synergies.

In order to further address speeding, the identification of the general road safety legislative framework in terms of regional road safety strategies, national road safety strategic plans as well as procedures foreseen by the Directive DIR2008/96/EC (European Commission, 2008) must be thoroughly examined.

In the current Road Safety Programme (2011-2020) of the European Union (European Commission, 2010), speed management consists a major concern, and therefore speed related issues are included in four out of the seven strategic objectives of the Programme (i.e. improved safety measures for vehicles, boost smart technology, better enforcement, a new focus on motorcyclists).

In the context of the European Directive DIR2008/96/EC, basic principles related to road infrastructure safety management have been defined, which among others, address certain procedures associated to road safety impact assessments, road safety audits, the management of road network safety and safety inspections. All these procedures are, to a more or less extent, related to speed management given that they aim to improve the conditions and make the road network safer. Therefore, the basic principles of these procedures, after being adjusted to meet local conditions and needs, form the core of the speed management strategy for local communities.

Finally, in order to develop an effective speed management strategy, it is necessary to identify the road safety situation in relation to speed (e.g. speed infringements, road accidents and casualties attributed to speed). This can help identify the magnitude of the problem as well as the particular characteristics and the conditions in the examined area.

2. SPEED MANAGEMENT STRATEGY IN SOUTH EAST EUROPE

Based on the particularities of the South East Europe as identified within the ROSEE project, the following sections outline and discuss the necessary elements of the speed management strategy in South East Europe in a comprehensive way, with emphasis on the strategy objectives, actions, implementation and monitoring.

2.1. Strategy Objectives

The basic aim of a speed management strategy is to reduce the number and severity of road crashes. Taking into account also the principles of the Safe System approach (SWOV, 2006; SNRA, 2006) the strategy involves a range of measures, introduced in the following action areas:

- Engineering treatments of road infrastructure in order to provide a road environment that supports and encourages road users to drive at safe speeds;
- Education on road safety and informational and awareness raising campaigns to establish a culture which rejects excessive speeding;
- Enforcement to identify and control intentionally and repeatedly speed offenders.

The following sections outline and discuss the proposed measures referring to each of the above action areas.

2.2. Action Areas

2.2.1. Engineering Treatments

The measures herein aim at providing a road environment that supports and encourages road users to drive at safe speeds. Planning the necessary actions and implementing them effectively requires that three basic principles are taken into account:

i) functionality, that is, speed values compatible with the operation of the road. The development of a clear hierarchy of the road network functions (flow, distribution, access) and the implementation of infrastructure and traffic arrangements for each network type accordingly is the starting point for a vehicle to be driven near the desired speed.

ii) homogeneity, i.e. there is uniformity in the mass and speed of vehicles using a road element, otherwise they must be adequately separated. During a crash, the human's physical vulnerability is revealed. Coexistence of road users with significant differences in mass or speed (e.g. cars/trucks vs bicycles) comprises an increased risk for the most vulnerable users. Therefore, an important measure in speed management is to ensure that incompatible road users do not share the same road parts.

The most effective way to reduce conflicts between motorised traffic and vulnerable non-motorised traffic is to separate them physically. However, this may be preferable on high speed routes carrying large volumes of through traffic, but is not always acceptable in mixed use environments where more interaction between different road users is desirable.

iii) predictability i.e. the design of roads should direct drivers to select the appropriate speeds. The appearance of the road has a significant effect on the speed at which drivers think it is appropriate to travel. The present principle aims at delivering a road environment that satisfies drivers' needs as well as expectations in terms of safety with a fairly constant, low mental workload. Sudden changes in vehicle's speed or path are usual signs of intense mental workload (Krammes et al, 1995).

A road environment which elicits safe behavior simply by its design without violating the drivers'expectancy is the basis where the "self-explaining" road approach relies on. Predictability is achieved by:

- Design consistency:
  Safety is correlated with design consistency (Polus & Dagan, 1987). Design consistency is defined as the degree to which highway systems are designed to ensure safety in traffic operation; if design consistency is present, the successive elements of a highway system act in a coordinated way and it results in performance from the drivers, i.e. no crashes (Gibreel et al, 1999). In general, consistency on the alignment is achieved by avoiding abrupt changes of alignment elements. Operational speed, which is one of the main factors in road geometric design is the most common mean utilized to assess the design consistency of a facility (Sanchez, 2012) because it is quantifiable (it can be measured). Substantial differences in successive elements between operational speeds or between design and operational speeds can increase erratic maneuvers and crashes (Park et al, 2010; Sanchez, 2012).
- Continuity in road course:

Continuity is defined as the ability of highway geometry to conform to driver's expectations. Besides being associated to geometric features, continuity is also the key factor that can ensure comfortable riding, aesthetic and coordination of nature (Hassan, 2004). Continuity is also closely related to psychological sight distance; the depth of the driving space, of which the driver supposes to have it completely registered, and comprises of adequate road and road environment field of view as well as information exposed forward, for which the driver feels comfortable in terms of avoiding abrupt maneuvers and speed variations (Lippold & Schulz, 2005). In many cases the psychological sight distance adequacy can be addressed by low cost engineering interventions.

Traffic Calming and Speed Reduction Measures

Certain engineering measures are commonly used to assist in traffic calming and speed reduction, especially at the approaches to urban areas. Such measures may include:

- roundabouts, when adequate space is provided
- design of transitional zones between rural and urban environment which give the visual impression of entry/portal areas
- installation of speedometers combined with variable message signs that will indicate the current speed of each passing vehicle
- installation of rumble strips or speed bumps and raised crossing platforms (urban areas only)

Speed Limits

The agency in charge must work out a speed zone design, taking into consideration the above mentioned, in order to eliminate excessive driving conditions. The operating speed is the critical traffic parameter that is related better with that speed limit which is considered reasonable and safe (Psarianos et al, 2009).

The criteria for establishing speed limits are:

- road functional classification
- alignment consistency and continuity
- skidding on curves
- stopping sight distance provision
- intersection and interchange areas
- accident data

Local speed limits are acceptable only if all potential engineering solutions for a given roadway section have been assessed or excluded.

It must also be ensured that the posted speed limit is readily and efficiently understood by road users. The required speed limit signs should be installed in a conspicuous and consistent way, with particular attention to high risk sites, to approaches to urban areas and to intersection approaches.

In cases of existing rural roads where local speed limits are necessary, the speed limit should be combined with an additional sign indicating the basis for setting the corresponding speed limit (e.g. sharp curve after excessive tangent length that violates design consistency).

Speed zones should be periodically revised and evaluated. As a general rule every 10 years all speed zones should be re-assessed to determine their appropriateness and functionality, taking into consideration besides geometric and operational data, accident records as well.

Concluding, the speed limits determination is a complicated process.

2.2.2. Road Safety Campaigns and Education

In order to establish a culture which rejects excessive speeding, public education campaigns must be developed and implemented, to provide information and influence road users to modify their behaviour. Such campaigns seek to change behaviour and remind road users of their responsibilities by putting key road safety issues on the public agenda. These campaigns also provide information on why speed is enforced in specific ways and the benefits that can be achieved by reducing speeds.

The public communication and education campaigns should involve a variety of means (radio, TV, newspapers & magazines, leaflets in toll stations, etc.) and should target the entire community, in order to achieve the desired behaviour change. The campaigns should focus on the following issues:

- inform road users about the consequences of excessive speeding, such as reduced time to realize and interpret driving related information, reduced margins to correct an error, increased accident severity, etc.
- persuade road users that excessive speeding is a dangerous and unacceptable behaviour
- inform road users that even if their speed is lower than the posted speed limit, it could be excessive if certain adverse conditions are met
- help road users realize the necessity of speed enforcement

In addition to anti-speed campaigns, an important aspect of road safety education should be to include road safety activities and knowledge in schools. Such road safety knowledge could include early familiarization of children with basic traffic regulations, with the identification of hazards in road traffic and with the consequences of dangerous road behaviour, such as speeding.

2.2.3. Speed Enforcement

Speed enforcement is probably the most efficient way to control excessive speeding. Effective speed enforcement leads to a rapid reduction in deaths and injuries. A previous study in Greece has shown that the intensification of enforcement has a direct impact on the improvement of driver behaviour and attitude and subsequently on the reduction of road accidents and fatalities (Yannis et al, 2008). Sustained intensive enforcement that is well explained and publicised also has a long-lasting effect on driver behaviour (ETSC, 2006). Worldwide, several speed enforcement methods are used; the automated ones (automatic speed cameras) are considered more effective because of the constant operation and the increased percentage of offenders' detection.

The following issues should be taken into account for the development of an efficient speed enforcement system:

- road users should be aware of speed enforcement activities

- speed controls and infringements should be recorded systematically, using proper equipment
- the locations for speed controls and the duration of the speed enforcement program should be carefully selected
- the results of speed enforcement activities (e.g. number of vehicles controlled, number of infringements, estimated accident reduction etc.) should be recorded and be publicly available
- the acceptability of speed enforcement is also expected to increase by setting proper speed limits and conspicuous speed limit signage, leading to the reduction of unintentional speed offenders.
- less urbanized and more road safety compliant regions are an easy target as far as enforcement is concerned. On the contrary, a more systematic effort would be required to achieve a more significant effect in the more urbanized and, therefore, less road safety compliant regions (Yannis et al, 2007).

2.3. Implementation of a Speed Management Strategy

The implementation of a speed management strategy should follow specific steps and take into account several aspects as described below.

2.3.1. Political and Community Support

The success of a speed management strategy depends overwhelmingly on winning the support of politicians, high-level community decision-makers and the community itself. Initiatives can fail because of a negative reaction from a vocal minority, in the absence of convincing evidence of the legitimacy of the scheme and the support of the majority.

2.3.2. Stakeholders and Roles

The involved agencies and authorities are the main partners responsible for the implementation of the proposed speed management strategy. The role and responsibilities of each partner should be clearly defined on the basis of the aforementioned action areas, in order to accomplish efficiently the objectives of the proposed strategy.

2.3.3. Preparing a plan of action

Before a comprehensive strategy can be implemented, a plan must be set up that defines the objectives and specifies clear actions for how the objectives will be met. The action plan must include a clear statement of problems and challenges in relation to public knowledge and awareness, legislation, engineering, enforcement and penalties. The time period considered adequate for the implementation of all the procedures and measures proposed in the strategy should be clearly set as well. In order to efficiently plan the strategy, the involved stakeholders and partners should seek and develop synergies with other policy areas, such as:

- the Ministry of Education for issues related to children road safety education

- various non-governmental organizations that can assist in organizing campaigns and events against speeding
- academic institutions and scientific organizations, for the monitoring and evaluation of the speed management strategy's implementation

2.3.4. Preparing for implementation

After obtaining approval for the implementation of the proposed strategy, it will be necessary to plan how it will be delivered. Besides the enforcement (police training, commitment) and engineering (design, construction) requirements, the team responsible for implementing the strategy should be defined. The team should possess a variety of skills to address all of the elements of the strategy (engineering skills, social and behavioural science, law enforcement, managerial and marketing, etc.)

2.3.5. Public Communication

In order to gain public acceptance and support for the proposed measures, it is very important that they are appropriately communicated through the following objectives:

- advising and educating drivers and other road users about proposed actions and expected behavioural changes;
- motivating compliance with speed limits and safe speeds;
- encouraging public support for the speed management strategy.

2.3.6. Planning and Using Pilot Projects

Pilot projects are a good way of assessing the methods selected for the full strategy without the same problems of scale. In general the same process should be followed, but in a limited area and over a limited period. A pilot project is a trial run. It doesn't matter if it doesn't run completely smoothly, provided that the appropriate lessons are learned.

2.4. Monitoring and Evaluation of a Speed Management Strategy

For a successful speed management strategy it is considered necessary to systematically monitor and evaluate the strategy's implementation and also periodically publish relevant reports. The benefits of a systematic monitoring, evaluation and reporting program are:

- the implementation progress and possible delays in certain action areas or specific activities are recorded, thus enabling suitable countermeasures;
- relevant activities can be updated and improved, taking into account the knowledge already gained;
- activities with minor road safety results can be isolated and the relevant resources can be utilized elsewhere;
- publication of the strategy's road safety results increases public acceptance of the speed management activities.

2.4.1. Monitoring of the Road Safety Level

Monitoring of the road safety level is performed through the use of selected road safety indicators, related to the number of road accidents or casualties, in accordance to traffic volumes. Such indicators are:

- number of people killed, heavily and slightly injured;
- the number of injury accidents, or damage only accidents;
- the number of accidents or casualties per million vehicle.km;
- the percentage of road users driving with excessive speed, etc.

2.4.2. Monitoring of Implemented Speed Management Activities

Monitoring of the road safety level is performed at national, regional or local level through the use of selected road safety indicators that allow for comparisons between the activities implemented and the ones that should be implemented, according to the strategy's timeline, such as:

- number and/or length of road segments, in which speed limits were evaluated and updated
- number and/or length of road segments, in which speed limit signage was improved
- number of engineering measures implemented, according to the 'self-explaining' road approach
- number of engineering measures implemented, aiming in traffic calming and speed reduction

2.4.3. Evaluation

The evaluation process needs to be designed around the objectives of the strategy, to see whether or not those objectives have been met. A well-designed simple evaluation can be as useful as a more complex and costly one.

Evaluation may take several forms, where one or more may be appropriate, depending on the aims of the strategy to be evaluated. Some examples are as follows:

- assessment of the efficient running of the operation, not the outcomes (e.g. necessary training, resources and equipment of police)
- impact assessment
- measurable effects of the strategy
    - qualitative (public opinions, perceptions, etc.)
    - quantitative (statistical analysis, performance indicators, etc.)

2.4.4. Dissemination and Feedback

The purpose of providing feedback is to sustain a sense of ownership and interest in the project by both the public and the stakeholders.

3. DISCUSSION

Speeding constitutes a serious road safety problem in Europe and worldwide. Most governments, worldwide, have recognised the need for action to address this problem and consequently reduce the number of road accidents and the severity of their consequences.

Given the complexity of the problem of excess and inappropriate speeds, there is no single solution to it. Furthermore, there is need for efficient integrated speed management strategies at local regional, national and international level, as the one presented at this paper for South East Europe. Such a strategy should tackle properly all critical elements, such as the objectives, the action areas, the implementation modalities and the road safety monitoring and measures evaluation. The main findings of this paper are summarized below.

A set of countermeasures is necessary, increasing the effectiveness of any speed management programme and strategy. All measures should be planned and implemented in the framework of an integrated speed management strategy.

The most appropriate combination of measures must be determined based on an assessment of the local circumstances (Štaba et Možina, 2014). Therefore, it is necessary to develop and implement a specific speed management strategy which will be based on relevant road safety data and will define all the necessary aspects of dealing with this critical road safety issue. Generally, measures included in the strategy should cover the key road safety aspects of engineering, enforcement and education.

Given that speed management is a highly controversial issue, political support is essential for a successful strategy. Political and community leaders must be informed and actively encouraged to support the speed management programme at the outset. Without this support substantial change is unlikely to occur (WHO, 2008). Such a support is even more necessary for the implementation phase of the speed management strategy.

The success and effectiveness of a speed management strategy is subject to further improvement through monitoring the road safety level on a systematical basis, evaluating the implementation of certain actions and publishing the strategy's road safety results.

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5. BIBLIOGRAPHY

[1] ETSC (2010). Tackling the Three Main Killers on the Roads. A Priority for the Forthcoming EU Road Safety Action Programme. PIN Flash n.16, European Transport Safety Council, Brussels, Belgium.

[2] ETSC (2006). Traffic Law Enforcement across the EU. Time for a Directive. European Transport Safety Council, Brussels, Belgium.
[3] European Commission (2010). Towards a European road safety area: policy orientations on road safety 2011-2020, European Commission, COM(2010) 389, Brussels, Belgium.
[4] European Commission (2008). Directive on road infrastructure safety management, Directive 2008/96/EC, European Commission.
[5] Gibreel, G.M., Easa, S., Hassan, Y., El-Dimeery, A. (1999). State of the Art of Highway Geometric Design Consistency. Journal of Transportation Engineering, Vol. 125, pp. 305–313.
[6] Hassan, Y. (2004). Highway Design Consistency: Refining the State of Knowledge and Practise. Transportation Research Record (1881).
[7] Krammes, R.A., Brackett, R.Q., Shafer, M.A., Ottesen, J.L., Anderson, I.B., Fink, K.L., Collins, K.M., Pendleton, O.J., Messer, C.J. (1995). Horizontal Alignment Design Consistency for Rural Two-Lane Highways. Publicación Nº FHWA – RD – 94 – 034.
[8] Lippold, C., Schulz, R. (2005). Orientation Sight Distance – Definition and Evaluation. 3rd International Symposium on Highway Geometric Design TRB, Chicago USA.
[9] OECD/ECMT (2006). Speed Management. Organisation for Economic Co-Operation and Development (OECD), European Conference of Ministers of Transport (ECMT). Paris, France.
[10] Park, P., Moreno-Miranda, L., Saccomanno, F. (2010). Speed-Profile Model for a Design-Consistency Evaluation Procedure in the United States. Canadian Journal of Civil Engineering.
[11] Polus, A., Dagan, D. (1987). Models for Evaluating the Consistency of Highway Alignment. Transportation Research Record, 1122.
[12] Psarianos, B., Palaskas, S., Stamatiadis, N. (2009). Greek guidelines for setting speed limits. Advances in Transportation Studies an international Journal (ATS). Section A 19.
[13] ROSEE – Road safety in South-East European regions, Project of the South-East Transnational Cooperation Programme (www.rosee-project.eu)
[14] Sánchez, J. (2012). Metodología para la Evaluación de Consistencia Del Trazado De Carreteras Interurbanas de dos Carriles. Ph.D. Madrid: Universidad Politécnica de Madrid.
[15] SNRA (2006). Safe Traffic, Vision Zero on the Move. Swedish National Road Administration.
[16] Štaba, R., Možina, K. (2014). Transnational Speed Management Strategy, ROSEE project, WP5: Safe Road Users.
[17] SWOV (2006). Advancing Sustainable Safety: National Road Safety Outlook for 2005-2020. Wegman, F., Aarts,L.
[18] Yannis, G., Laiou, A. (2014). Speed management strategy for Peloponnese (Greece), ROSEE project, WP5: Safe road users.
[19] WHO (2008). Speed Management. A Road Safety Manual for Decision-Makers and Practitioners.
[20] Yannis, G., Papadimitriou, E., Antoniou, C. (2008). Impact of enforcement on traffic accidents and fatalities: A multivariate multilevel analysis, Safety Science, Vol.46.