INTELLIGENT SPEED ADAPTATION
THE DUTCH EXPERIMENT IN AN URBAN AREA

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SUMMARY

In the last few decades, the growing mobility of people has exceeded the expansion of road capacity. Therefor many initiatives have been taken to improve traffic safety of which Intelligent Speed Adaptation (ISA), used as 'electronic traffic calming', is one of the latest.
The Netherlands is planning to experiment with ISA in an urban area; incorporating studies in mixed traffic (ISA and non-ISA) and in an area exclusively for ISA traffic.
The experiment will be realistic in such a way that the technologies for communication and speed limiting in-vehicle, are technologies that might be used in an eventual real implementation of ISA in urban areas. This means that performance, reliability and the possible use on a larger scale, will be taken into consideration.
The evaluation activities in the Dutch experiment are aimed at showing whether expected safety effects, traffic performance and environmental advantages are founded.

INTRODUCTION

In the last few decades, the growing mobility of people has exceeded the expansion of road capacity. The amount of kilometres driven per year is growing excessively, due to the fact that the car is becoming a common good which everybody uses. Society is placing more and more emphasis on individual mobility and public transport seems to be unable to provide for this growing demand. Because of the excessive demand for mobility, problems of congestion and safety are increasing.

Each year there are many casualties on European roads (the past few years for example there have been about 1200 deaths in the Netherlands annually (1)). There are many causes for this, but there is a clear relationship between the severity of the accident (probability of injury and/or death) and the speed of the vehicle. Many initiatives have been taken to improve traffic safety, including other policy aspects, such as traffic flow, quality of life, and the environment. Various routes can be taken when formulating a traffic safety policy. For example, infrastructure (design), technology in the vehicle and along the road, control legislation, and influencing behaviour are different aspects that demand different approaches in the safety policy.
When looking at the technology developments, communication and vehicle intelligence, are tools that can be combined very well in order to enhance safety.
Technologies in the vehicle and along the road are developing very fast, and may be the most promising of the different routes to follow. Vehicles have more and more features that concern engine, driving and vehicle dynamics control on board. Communication with the roadside is likely to become a standard feature in the future. At this moment, several initiatives have been started to test and implement communication for traffic enhancement, like broadcasting of information on weather, traffic and travel circumstances.

One of the present technological developments is Intelligent Speed Adaptation (ISA). ISA is a tool that can be used for "Electronic Traffic Calming". It is defined as follows:

"Intelligent Speed Adaptation comprises processes which monitor the relationship between current speed of a vehicle and a suitable speed and have a corrective effect when this relationship is incorrect in the vehicle" (4)

This means that speed limit information which is specific for the local road and traffic conditions, has to be available in vehicles on that road. In the vehicle, this information is used to inform, stimulate and/or correct the driver.

Until now no European country has a specific policy on ISA, although a few experiments on small scale are carried out or planned in the near future.

The Netherlands is planning to experiment with ISA in the near future. Today a new district in one of the cities in the Netherlands is designed with the possibility to study the application of ISA. This paper gives an overview of the technical aspects and the planned way of carrying out the evaluation of this study.

CONSIDERATIONS ON THE IMPLEMENTATION OF ISA

When discussing the issue of ISA, different alternatives of Speed Control can be looked at, along with the implementation possibilities of these alternatives in society. Major differences between the various alternatives are:

- Appearance of ISA, that is, should ISA be an instrument that only informs the driver (advising) about speed limits, or should ISA be more active, in the sense that it can stimulate the driver, e.g. by means of a reaction force on the gas pedal (stimulating), or should it even prevent the driver from driving faster by limiting the possible speed of the vehicle (enforcing).
- Implementation location. Should ISA be implemented on highways, rural roads or in urban areas?
- Technology. Of course, different technologies are available for ISA. ISA, as it is seen at this moment, will have to be a combination of existing technologies, like beacon technology, GPS/GSM technology, combined with in-vehicle systems.

The various alternatives for the implementation are interrelated: Should ISA be carried out advising, on a highway, using GPS/GSM, or should it be enforcing, on rural roads with beacons? Arguments for the different alternatives are based on the interests of the different stakeholders in ISA:

- Road users, who might see ISA as a useful tool to prevent speeding tickets, enhancing safety and improving comfort on different road-types, and those who might see ISA as "big brother";

- Industry might see advantages on comfort and enhanced passive safety, but might also see ISA as a threat for their competitive possibilities;
- By traffic management ISA is seen as a possibility to improve traffic flow, and improve road safety.

In order to assess all the issues, arguments and technical implementation possibilities, it is necessary to conduct surveys and experiments. In the next paragraph, the activities in The Netherlands are described, and a few European initiatives are listed, which are, or could be linked with the Dutch initiative (4).

PLANNED IMPLEMENTATION IN THE NETHERLANDS

In the Netherlands, an experiment is planned in an urban area, that incorporates studies in mixed traffic (ISA and non-ISA vehicles combined) as well as an area that will be exclusively for ISA traffic.

Set-up of the Dutch experiment
In the Netherlands, an experiment is planned in an urban area that is to be built at the end of the century. The main goals of this experiment are to create awareness and enhance acceptance amongst the public, and to build up knowledge about effects of ISA. It is believed that the advantages of ISA in an urban area, namely "quality of life" because of enhanced (perceived) safety, and infrastructual advantages, can best be demonstrated in an urban area. Furthermore, studies that have been carried out before have shown that road users believe that urban areas might take most advantage of ISA. Finally, an advantage from an experimental point of view is that an urban area can be monitored effectively, because of the fact that there is only a limited, recognised group of road users, namely the inhabitants of the area (in contrast with rural roads and highways).

The experiment will be carried out with 300 to 600 ISA vehicles (10% to 20% of all vehicles in the area), so possible collective effects can be assessed too. The experiment in the urban area will be preceded by a test with a few vehicles, in order to establish a basic awareness amongst future inhabitants, to optimise and demonstrate the functional aspects of the chosen ISA alternative. After this "introductional" test, it will be able to decide which will be the best ISA alternative to introduce.

In order to be able to measure pure (and which is expected to be the most effective) effects of ISA, without being biased in several ways, the experiment will be carried out in an enforcing way: ISA drivers will not be able to drive faster than set speed limits. This also creates more freedom for the infrastructural design, namely to leave out speed bumps and other speed restricting measures. It goes without saying that the roads should still be built in such a way, that drivers still perceive the speed limit as matching the road environment. This is an advantage that is only relevant to the enforcing of the ISA alternative. In other alternatives, that do not limit the speed in an absolute way, roads still have to be equipped with the speed limiting measures.

To establish "understandable speeds", speed limits are varied dynamically on different road sections. For instance, at times of school beginning and closing, speed limits in the neighbourhood of that school will be lower than the rest of the day. This forms the basis for INTELLIGENT speed adaptation.

During and after the experiment, the behaviour of road users (ISA users as well as a few non-ISA users in the urban area) will be monitored. Actual speeds will be compared to speed limits, compensating driving behaviour on roads outside the ISA area can be monitored, and vehicle related aspects of ISA (fuel consumption, emissions and possibly the wear of the vehicle) can be monitored.

The experiment will be realistic in such way that the technologies for communication and speed limiting in-vehicle, are technologies that might be used in an eventual real implementation of ISA in urban areas. This also means that also performance, reliability, and the possible use on a larger scale, are taken into consideration when working out the used technologies. A lease car concept will be used: the people who participate in the tests and experiments, will be provided with an ISA equipped lease vehicle. This has several advantages, technical, organisational as well as concerning acceptance. Possibilities of fraud will be of lower priority in the experiment.

Framework: European initiatives

In order to find out different estimated effects of ISA, several investigations into the feasibility and acceptance have been carried out by different organisations in Europe. For instance, in Great Britain a Stated Preference survey has been carried out on the issue of speed limiting alternatives. In Sweden there have been several actual experiments with different technologies, in which the individual response of drivers, and the acceptance of the idea of ISA before and after using ISA were emphasised (4).

EVALUATION

ISA has huge potential benefits in several areas: safety, traffic performance, and the environment (e.g. energy consumption, noise, exhaust gas). The evaluation activities in the Dutch experiment are aimed at showing whether such effects are indeed found. A direct effect of ISA on such variables will be hard to prove during an experiment as planned, in an urban area. For example, since the frequency of traffic accidents in residential areas is already quite low, it is difficult to prove a reduction in this variable due to ISA. Therefore, the emphasis will be more on intermediate variables.

The primary effect of ISA is, by definition, an effect on *speed*. For an effective ISA, speeds above the set limit should no longer occur. In this way, ISA would influence the distribution of speeds: both the mean and the standard deviation of speed would be reduced (between as well as within vehicles). This homogenising effect on speed is expected to influence traffic safety, traffic performance and environmental variables. Therefore, speed will be an

important evaluation variable. Speed can be measured on fixed locations, within a group of vehicles, or a combination. Such measurements will allow to make a comparison of speed choice between ISA and non-ISA vehicles, distinguishing between areas with and without ISA being active.

Video recordings can not only be used to measure driving behaviour variables (speed, following behaviour, gap acceptance, etc.), but also for the purpose of conflict analysis, e.g. using the DOCTOR method (2). Changes in the frequency and severity of conflicts due to ISA can be used as indicators for changes in traffic safety. Furthermore, it is intended to study effects on route choice, especially since in the Dutch study a part of the road network will be accessible only for ISA-vehicles. Finally, questionnaires or interviews will be used to investigate variables such as subjective safety, (changes in) attitude towards, and acceptance of ISA, etc.

In addition to such observational studies, the Dutch experiment offers a suitable test environment for more controlled studies using instrumented vehicles. This would allow us to study, on a small scale, several ISA design alternatives or Human Machine Interface (HMI) aspects, yielding information that can help to optimise the ISA system design.

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