DAYTIME RUNNING LIGHTS (DRL)

A master plan for evaluation research

(Shortened version)

R-89-24

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Leidschendam, 1989

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CONTENTS

INTRODUCTION

It is generally assumed that improved visibility of motor vehicles can make an important contribution to road safety. There are various ways to improve the visibility of motor vehicles. One of these is the use of daytime running lights (DRL). Based on current data (1986), the Dutch Institute for Road Safety Research (SWOV) has estimated a reduction of approximately 5% in the total number of injury accidents. These considerations have had a significant influence on the decision to introduce compulsory use of daytime running lights in the Netherlands after 1990.

The basic research activities to enable a sound evaluation study of the effect of DRL are described in the master plan.
On April 3rd, 1989, the Road Traffic Department of the Dutch Ministry of Transport commissioned SWOV to draw up this plan. The aims of the plan are:

- to provide an overview of the projects and their interrelationships;
- to provide an insight into the outcome of the overall study;
- to show how the results of this study may be used;
- to define the nature, scope and organisation of the activities.

The Minister of Transport of the Netherlands has suggested that the other European countries also should implement this DRL ruling. Although the surrounding countries have not (yet) adopted this regulation, they are keen to see the effect such a measure will have in the Netherlands. An international committee has therefore been appointed which will follow and guide the progress of the Dutch study. Therefore, the committee will receive the first part of the master plan, which containts an overview of the study programme.

Following consultation between the commissioning body and SWOV it was decided that the study will be directed towards the following six points:

1. An <u>evaluation</u> of the effect of the regulation on road traffic safety in the Netherlands.
2. A study into the <u>theoretical explanation</u> for the efficacy of using daytime running lights.

3. A study of public acceptance, the influence campaigns would have on this and possible side effects of the regulation for particular groups in the community.
4. The assimilation of relevant information from the Dordrecht Demonstration Project into the national introduction of DRL.
5. International guidance of, and involvement in, the Dutch study.
6. A study into the technical support possibilities.

An extensive study, in terms of both time and the constituent parts, is required in order to do justice to these six aspects. An extensive evaluation study is justifiable if the introduction of regulation incurs considerable costs and if the effect of the regulation cannot be assessed accurately enough in advance (Hauer et al., 1984). This is the case with the introduction of DRL in the Netherlands. However, on the basis of (inter)national cost savings estimates, one could expect a saving of over 200 million guilders annually in the Netherlands, even with an accident reduction of 5% (NPV, 1985).

The results of the study are not only intended as a retrospective verification or explanation of what has occurred. The study is also - and particularly - intended to give concrete support for the design and introduction of the regulation.
This includes such activities as information campaigns, surveillance to ensure compliance with the regulation, the stimulation of technical developments and (inter)national consultation between government departments.

This report was prepared by drs. J.E. Lindeijer in close collaboration with dr. A.S. Hakkert and based on work already done by dr.ir. D.A. Schreuder.

OVERVIEW OF THE STUDY PROGRAMME

1. GENERAL

For reasons of content and organisation, the study has been divided into a number of projects:

- Project A: Evaluation: accident study.
- Project B: Evaluation: use of DRL.
- Project C: Evaluation: public acceptance.
- Project D: Theoretical interpretation.
- Project E: Demonstration project Dordrecht.
- Project F: International guidance for the Dutch study.
- Project G: Guidance for the development of technical aids.
- Project H: Cost-benefit analysis and reporting.

The efficacy of the regulation must initially be proven by the number of accidents (project A). However, this depends on actual use of DRL (project B), which is in turn dependent on the public acceptance of DRL (project C). All three types of data (accidents, usage and acceptance) are therefore required in order to establish with hindsight how DRL works and whether it has proved to be effective. The theory will then need to explain why DRL has been effective (project D). The project E will provide the preliminary information for projects A, B, C and G (the first part of project E is a pilot study). The data from projects A, B, C, D, E and G also serve to indicate - prior and subsequent to implementation - how the efficacy of the regulation may be accelerated or increased. To achieve this objective, measurement at a number of points in time are necessary, with the opportunity of distinguishing between the sub-groups of road users, driving conditions and accidents.

Collectively, these projects should provide the information required. In addition, the results of one section project should be available for use by the others (see diagram). Furthermore, data collection must be carried out at the appropriate points in time. All these factors need careful integration of content and time planning for the projects and their sections.

2. PROJECT A: EVALUATION: ACCIDENT STUDY

This project consists of a number of sections:
a. Accident analysis on a national scale.
b. Accident analysis on a limited scale.
c. Fleet-owner studies.

Accident analysis on a national scale (section A.a) must enable general statements with regard to changes in the number of accidents on a national scale as a result of DRL. These statements must be distinguished according to type of accident, road users involved and the driving conditions, in relation to consecutive periods of time.

The anticipated drop in the number of accidents depends on the extent to which DRL is used (incl. input data from project B), and on the efficacy of DRL (theoretical support: project D). Use should increase with time, but this may not be uniform under all circumstances. The efficacy of DRL could be depend on circumstances, and may be greater for one accident group than for another. The expectations must be formulated on the basis of experiences abroad, test projects in the Netherlands itself and on the basis of theoretical knowledge. Assessments will be made with regard to whether the separate groups of accidents develop according to expectations and in accordance with the measured growth in use of DRL. The results of user measurements must therefore be categorised into the same groups as the accident statistics.
For certain accident groups, no change can be expected as a result of DRL. Their development serves as a control for other influences on the number of accidents. Developments in preceding periods and abroad will also be included in the examination.

It would be ideal if - to enable a direct national comparison between DRL users and non-DRL users - for the duration of the evaluation study, the police would record whether the motor vehicles involved (in accidents) were driving with DRL.
By comparing DRL use by motor vehicles involved in accidents with the percentage DRL use under comparable circumstances (input data from project B), the efficacy of DRL can be calculated. Another examination could be carried out under the same circumstances (and therefore with the same

proportion of DRL use) to examine whether certain types of collision occur less frequently, while they do occur more frequently in the case of vehicles not driving with DRL. Using this data (use of DRL in accident cases), the statements with regard to the efficacy of DRL will carry even more weight.
The actual likelihood of realising such additional police registration on a national scale is doubtful, however.

Non-registration of DRL use therefore requires an additional accident study on a more limited scale (section A.b). This means that cooperation of local police forces (on regional and municipal level) will be requested. With regard to the request for cooperation, maximum possible spread of the various forces over the Netherlands will be taken into account. The fact that this method of operation has a good chance of success is proven by the cooperation already given by the municipality of Dordrecht (see project E).
In those cases where cooperation is obtained, a more extensive accident analysis may be carried out and compared with local user data (see project E and project B).

To increase the number of accidents on local level, cases with material damage only which have been recorded by the police can be included in the analysis.
Police keep fewer records of accidents in which material damage only is reported than of cases involving personal injury. In addition, it is obvious that the Dutch police does not forward all their reports concerning material damage cases to Road Accident Records Office VOR. At the national level, the scope of this type of accident can only be estimated. This is the reason why - at a national level (section A.a) - this 'type' of accident is not included in the analysis. At the local level, copies of police reports can probably be used. Results from this part of the project therefore have a supplementary (added) value with regard to supporting the effect of the regulation in terms of a reduction in accidents.

In order to complete the argumentation, an attempt will be made to obtain the cooperation of fleet owners (section A.c). This cooperation would have to consist of:

- either having half the fleet of cars use DRL, or having the entire fleet of cars use DRL;
- providing descriptions per accident per vehicle for the duration of the study.

Methodologically, the first form of cooperation has an advantage over the second. When half the fleet of cars use DRL and the other half does not, this offers the opportunity of comparing the development of accidents in the DRL group and the (control) group not using DRL. Autonomous changes in the number of accidents during the study can be traced in this way (Polak, 1986). Where all vehicles use DRL, only a preliminary and retrospective study would be possible.

Another advantage is that drivers can be asked specifically about their experiences with DRL with regard to their feeling of safety (associated with project C).

However, there are a number of statistical restrictions attached to this material.

The average number of accidents per vehicle per year (even if cases involving material damage only have been included in the analysis) will be small. This implies that even a reduction of 20%, for example, would often lack statistical significance (Polak, 1986). It may be assumed that the composition of such car fleets will be different from the composition of the total number of cars on the road nationwide. If cooperation is obtained, one would have a group using DRL when the other traffic has not reached that stage yet. Although this will affect the validity of the data, it offers the opportunity to describe the process from a gradual increase in user percentage in terms of accidents and experiences at a micro level.

There are therefore restrictions attached to the practicability of this material, which do not allow generalised statements at the national level. However, statements based on this material will supply a worthwhile contribution, as findings at a micro level will reinforce national statements.

The extent to which data for accident cases at a local level (section A.b) and/or by fleet owners (section A.c) can be obtained is not clear as yet.

3. PROJECT B: EVALUATION: USE OF DRL

In the first place, use of DRL is of direct importance in order to evaluate the level of compliance with this regulation.
In the second place, user data is required in order to evaluate the influence of information campaigns and specific activities (such as efforts related to enforcement policy and local activities). Differences in usage can provide a reason for conducting local campaigns or for demanding extra effort from the side of the police. Development in the course of time can demonstrate the efficacy of these activities. The measurements of public acceptance (project C) can also be used in this way. Of course, it would be most advantageous to integrate both projects.
Thirdly, data concerning use of DRL is necessary for the evaluation of the regulation in terms of a reduction in accidents. This means there must be a clear connection between project A and project B.

The measurements are designed in such a way that the influence of a large number of factors which have demonstrated the difference in use of DRL, or which may be expected to differ in efficacy have been taken into account. These factors include: point in time, type of road, lighting conditions and the like.
Three requirements of the measurement programme are therefore:

- The measurements must show user percentages at a national level. This means a proper spread of measurement sites over the whole country.
- The measurements must show the user percentage as a function of the most important factors of influence. This means that measurements should register seasonal influences and that the times of measurement have been properly spread per measurement site (e.g. demonstrate a relationship with peak times for accident cases).
- The measurement sites must be selected such that the link between results and accident cases can be established. This also means that factors such as measurements inside and outside built up areas, on motorways and 80 km roads (outside the built up area) and the possibility of conducting measurements under various weather conditions should be taken into consideration.

It may be assumed that a side effect of the introduction of the DRL regulation will be that car lights will wear down (much) more quickly. As

a consequence, more frequent instances of driving with one broken lamp might be recorded. On the other hand, it could also mean this might occur less than at present, because more care will be paid to this matter. In order to follow this process and include it in the accident analysis, measurements must also be carried out to this end. These measurements will not be extensive. Supplementary data may be obtained by collecting numerical data with regard to the turnover of car lamps, a small survey conducted at car workshops and/or the Royal Dutch Touringclub ANWB. This factor can also be included as a question in the survey associated with project C.

4. PROJECT C: EVALUATION: PUBLIC ACCEPTANCE

Compliance with regulations increases as road users become better informed and understand the reason for the regulation more clearly. Aside from information, motivation therefore plays an important part.

A study into the public acceptance of the DRL regulation is essential for a number of reasons:

- Estimation of the acceptance level. The extent to which drivers claim they will actually use daytime lights if the regulation is introduced. Data from these measurement will provide the base material for information campaigns and/or specific activities.
- Measurement of drivers' willingness to purchase technical aids themselves, measurements of developments in this regard and the motivations and choices made. Data about this serve as input for project G: Guidance for the development of technical aids.
- Evaluation of the effect of information campaigns and specific actions. This data is required for a cost-benefit analysis (project H), to make interim adjustment of information possible, to determine to what extent specific activities must be implemented or adjusted, and for timely action if a decrease in use is expected as a result of habituation. Experience with accelerated wear of the lamps may be an argument drivers employ to adhere less strictly to the DRL regulation.
- To identify the creation and development of side effects. Certain groups in society (e.g. the elderly and young children) may feel threatened by the introduction of the regulation, which may lead to a restriction of their mobility.

In addition, groups of other traffic participants (e.g. motor cyclists and/or moped drivers) may feel threatened by the introduction of the DRL regulation. By identifying these problems in time, the government is given the opportunity of taking compensatory action.

Surveys will be used as the study method. Based on the results of a preliminary measurement, in which the usefulness and validity of the questionnaire was tested, four national surveys will be conducted.

- The first measurement must take place before the commencement of the information campaigns.
- The second measurement will take place following the big information campaigns.
- The third measurement is planned a few months following the introduction of the DRL regulation.
- The last survey is planned (approximately) two years following the introduction of the regulation. Based on the results of this survey, the influence of habituation to DRL can be established.

The sample will include an estimated 1200 to 1500 people per target group (at least) - depending on the question to be posed and the required accuracy of the result - providing the sample has been carefully stratified. For the planning of the survey, experiences gained in the municipality of Dordrecht will be utilised (the relationship between project C and project E).

5. PROJECT D: THEORETICAL INTERPRETATION

There is sufficient confidence that DRL will help to improve road safety in the Netherlands. The scope of this contribution (i.e. the reduction in the number of accidents) and the explanation for the efficacy of DRL are less certain.
This is the reason why the project will consist of two sections, with a possible extension to a third section. The rationale for this extension will need to be shown by the first two sections. The relevant sections are:

a. Preliminary study.
b. Theoretical study (laboratory research).
c. Behavioural observations (= optional field study).

The preliminary study (section D.a) will include a supplementary study of the literature, which will examine the most recent international study results (from 1985 onwards) in particular. The aim of this preliminary study is to generate hypotheses for:

- The accident study (project A) : which categories of accident (types) have been used in other countries, the extent to which comparison with Dutch results are possible and what type of categorisation of accident data is possible, useful and why?
- The study into public acceptance (project C): which experiences have been gained abroad with regard to information campaigns and what was the outcome?
- The theoretical study (section D.b): what has been investigated, what has not and is necessary and feasible?
- Study of behaviour (section D.c): what has been studied, what has not and is necessary and feasible?

The core problem for the theoretical study (section D.b) will concern the question: how does DRL work in a physiological and psychological sense? The answer to this question is of importance in order to justify the value of the regulation in terms of expected reduction in accidents and/or changes in behaviour (related to project A, section D.a and project C) and in order to provide a subsequent explanation of the efficacy of the regulation (relationship with project A and project C).
Better insight can also be gained into the functional and photometric requirements of DRL (relationship with project G).

This means that the theoretical study (laboratory research and behavioural observations) will be an explanatory study which will be directed towards the acquisition of greater insight into the functioning of DRL, and should contain the following aspects:

- observation (motor-vehicle/slow traffic) (partial/complete use of DRL);
- cognitive aspects (motor-vehicle/slow traffic) (partial/ complete use of DRL);
- behavioural aspects (motor-vehicle/slow traffic) (partial/ complete use of DRL).

6. PROJECT E: DEMONSTRATION PROJECT DORDRECHT

In the context of the Campaign -25%, the Municipality of Dordrecht has decided to conduct a campaign amongst its public, where drivers of motor vehicles are encouraged to use DRL. This stimulation is expected to be further enhanced as a result of the municipal fleet of cars using DRL as from a certain date set in 1989.

Initially, the entire campaign was not planned and set up as a study. However, the data which will be made available (at municipal level) will be regarded and processed as data from a pilot study. The data will be used for the planning and supplementation of: sections A.b and A.c, project B, project C and project G.

Continuation of the Dordrecht project during the entire course of the study offers the opportunity of deducting the extra investments related to this project from the costs for project B and section A.b. In this way, user measurements in Dordrecht will be considered as one of the measurements with regard to the use of DRL (project B). These are also required for accident analysis at the local level (section A.b). Whether the number of accidents per municipal vehicle will be adequate for a fleet-owner study will be dependent on the scale. In order to ensure the usefulness of this data for the large evaluation study, support and guidance is required in this campaign in relation to:

- measurements of user percentage of DRL (relationship with project B);
- evaluation in terms of accident cases (relationship with sections A.b and A.c);
- evaluation of public acceptance (relationship with project C);
- technical optimisation (relationship with project G).

7. PROJECT F: INTERNATIONAL GUIDANCE FOR THE DUTCH STUDY

At an international level (EC, but also CEMT) the results of the Dutch studies will be considered of great importance for the formulation of any recommendation to other countries to instigate such a ruling. In the short term, support for the proposed international work group is particularly necessary (advisory group; guidance group). Their special task will be to guide the (future) study conducted in the Netherlands.
With regard to the Dutch accident study (section A.a), it is desirable to consider the Belgium, English, French and German accident cases as a 'control group', for example. This allows a comparison of the effect of DRL at an international level, at least if correction for the most important factors is possible. An international comparison requires close collaboration between the Netherlands and the other countries which may be realised by this committee.

The SWOV will also ensure that an extensive English and French summary of the reports is provided for each project. On completion of the study as a whole, a complete English and French translation of the final report will be supplied.

8. PROJECT G: GUIDANCE FOR THE DEVELOPMENT OF TECHNICAL AIDS

The willingness to comply with the regulation will also depend on the effort which road users must expend. It is important to encourage the Dutch industry to investigate how technical aids can be optimised (in terms of economy for the consumer and to preserve the environment).

The market study (in relation to user potential) may be considered a task for the industry. The design, development and testing of equipment would seem to require a joint effort between the government and the industry. It is questionable whether the technical aids developed and tested in the demonstration project Dordrecht (project E) have been sufficiently researched; sufficient in the sense that environmental and economical aspects have been taken into consideration during the development of these aids. If the government wants to provide the public with sound, technical information, it must achieve an insight into the quality of these aids. Early government participation offers the opportunity of formulating a number of timely requirements.
SWOV will guide these activities to provide an insight into the cost aspect (project H).

An initial orientation with potential fleet owners would seem to indicate that the cost aspect (increased petrol consumption and accelerated wear of the lamps as a result of DRL) would form an obstruction to cooperation. Therefore, an initial test of these objections must be carried out as soon as possible. Not only to increase the possibility of cooperation of fleet owners (section A.c), but also to support the information campaigns with relevant documentation (project C).

9. PROJECT H: COST-BENEFIT ANALYSIS AND REPORTING

This project will include three activities, to be divided into:

- Progress reports

During the entire period of the study (approx. 5 years), an annual report will be published. This report will be considered to be an annual duty of the commissioner and will include the following items:

- progress made;
- concluded sections in relation to time planning and cost estimation;
- interim adjustment to the projects (giving reasons why) and the anticipated consequence(s) for the usefulness of the end results;
- an English and French summary for the international steering committee (project F).

- Cost-benefit analysis

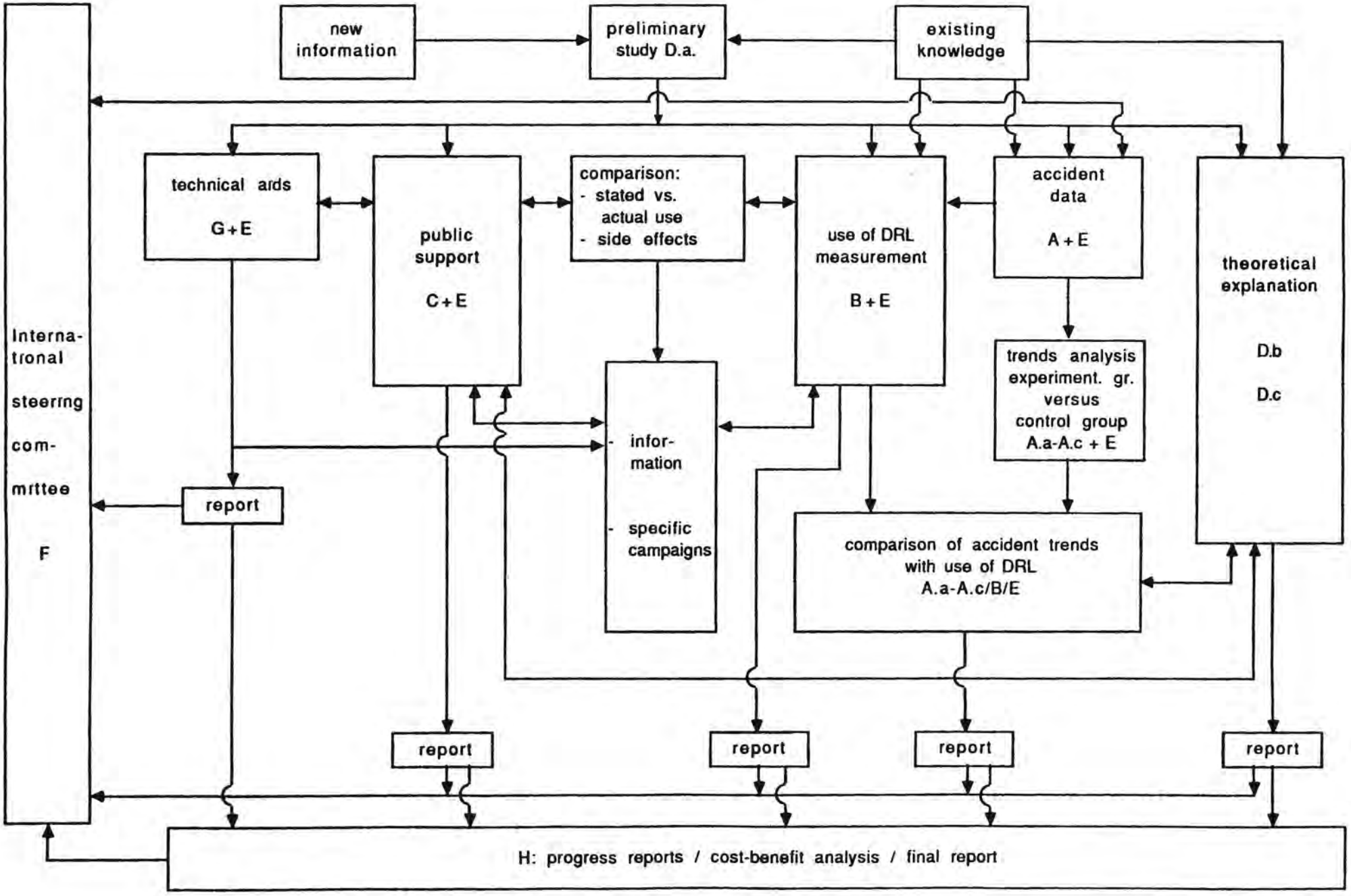
The Netherlands can only introduce the DRL regulation on a national level as a rule of conduct. The rule of conduct for road safety can be considered to have optimal effectiveness if it is adhered to as universally as possible. To realise this aim, the government will have to be prepared to invest in extra effort. The cost-benefit analysis will therefore assess the extent to which costs and effort put into the realisation will prove to be a sound investment (and will remain so). The reason for this analysis taking place during the last phase of the study is because all data must be gathered first.

The analysis will include specifications for technical requirements associated with the use of DRL in motor-vehicles. It will also include an estimate of the cost-effectiveness of DRL regulations in other countries.

- Final report

Each project will conclude with a report, which will give an account of the results that have come out of the specific project.

Aside from these reports, a final report will be compiled on completion of the overall study; here the results of each project will be described in terms of their interrelationships. The entire final report will be translated into English and French.


new information
preliminary study D.a.
existing knowledge
Interna-tional steering com-mittee F
technical aids G+E
public support C+E
comparison: - stated vs. actual use - side effects
use of DRL measurement B+E
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theoretical explanation D.b D.c
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- infor-mation - specific campaigns
report
comparison of accident trends with use of DRL A.a-A.c/B/E
report
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report
report
H: progress reports / cost-benefit analysis / final report

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