DAYTIME RUNNING LIGHTS (DRL)

A master plan for an evaluation study in The Netherlands

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J.E. Lindeijer
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SWOV Institute for Road Safety Research, The Netherlands

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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 in the fall of 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 as well as activities 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 and report to the European Committees.

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

1. An evaluation of the effect of the regulation on road traffic safety in the Netherlands.
2. A study into the theoretical explanation 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 II, 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 J.E. Lindeijer in close collaboration with dr. A.S. Hakkert and based on work already done by dr. D.A. Schreuder.

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.

Following a general introduction, approach and implementation will be described for each project in relation to the following:

- selection and justification of analysis methods (project A, statistical and methodological);
- selection of the measurement programme to evaluate DRL (project B, statistical and methodological);
- the relationship between accident analyses and measured user percentages (= measurement results);
- selection and overall organisation of the surveys (project C, statistical and methodological);
- the relationship between accident analyses, measurement results and public acceptance;
- selection and overall organisation of the theoretical study (project D, methodological);
- the relationship between accident analyses, measurement results and the theoretical study;
- the continuation of Demonstration Project Dordrecht (project E), justification for including this data in the accident analyses, measurement programme, survey and technical study;
- impetus for an international cooperation (project F) with regard to the accident analysis, the collection of measurement data and the theoretical study;
- a first step towards a study into the development of technical aids (project G);
- the relationship between the technical study, public acceptance and measurement results;
- overall approach for the cost-benefit analysis (project H).

Up until today, much national and international criticism has been voiced about the studies on the effect of DRL in terms of a reduction in the number of accidents. Criticism is mainly directed towards the measurement programmes, accident analyses and public compliance with the regulation. The SWOV has already obtained a reasonable insight into the anticipated problems and restrictions, thanks to the pilot study in Dordrecht. For this reason the most important projects (A, B, C and D) will deal with the following subjects in greater depth:
- anticipated difficulties in obtaining sufficient data;
- restrictions associated with various information sources;
- approach methods selected to solve problems and/or restrictions.

2. PROJECT A: EVALUATION: ACCIDENT STUDY

2.1. Introduction

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 (input data from project B), and on the efficacy of DRL (theoretical support: project D). It is expected that use will 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 assessed. 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 co-operation of local police forces (on regional and municipal level) will be requested. Maximum possible spread of the various forces over the Netherlands will be looked for. The fact that this method of operation has a good chance of success is proven by the co-operation already given by the municipality of Dordrecht (see project E).
In those cases where co-operation 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 that may be used for the analysis, damage only accidents which have been recorded by the police can be included.
Police keep fewer records of damage only accidents than of injury accidents. In addition, it is customary that the police does not forward all their reports concerning material damage cases to Road Accident Records Office VOR. At the national level, the number of this type of accident can only be estimated. This is the reason why - at a national level (section A.a) - damage only accidents are not included in the analysis. At the local level, the actual police reports probably can 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 collect additional data, an attempt will be made to obtain the co-operation of fleet owners (section A.c).

There are 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.

2.2. Approach and realisation

2.2.1. Section A.a.: National accident study

• Information sources

Accident file of the Dutch Road Accidents Records Office VOR (injury and/or fatal accidents).

Literature sources have shown variations in the percentage of DRL use (as a function of time); they are influenced by the following variables:

- the road user;
- the location;
- the weather, time of day and the like;
- the type of road (motorway, main roads and the like);
- inside or outside the built up area, environmental factors;
- the type of vehicle.

To conduct a national accident study in the Netherlands, the following data will be required:

- o province
- o inside or outside the built up area
- o month and day of the week
- o time of day
- o weather conditions
- o type of road user
- o type of road
- o use of DRL

The first six variables may be drawn from the VOR file. Neither the type of road, nor the use of DRL is directly available.

• Type of road

This data will be obtained by combining the 'speed limit' factor at the site of the accident with the 'inside or outside the built up area' factor which are available from the VOR-file, allowing formulation of a reliable breakdown according to:

- motorways outside the built up area;
- 80 km roads outside the built up area;
- 50 km roads inside the built up area.

• Use of DRL

Motor vehicle use of DRL is one of the most important information items required for the analysis. This data is lacking and cannot be estimated by combining other (existing) VOR data.

Therefore, average user percentages derived from national measurements (project B) will be linked to the aggregated number of accidents (see also section A.b).

• Accidents relevant to DRL

Accidents relevant to DRL include those accidents where it may be assumed that the use of DRL could have been influential in the accident. In any case, this will concern those accidents which took place during the daytime. In 1988, the proportion of daylight accidents was approx. 70% of the total number of accidents.

• Statistical restrictions

Two problems may be distinguished for an evaluation study into the effect of a regulation in terms of accident reduction:

- The demonstration of a statistically significant reduction.
- Attributing a significant reduction to the influence of one specific regulation.

On the basis of existing data, the SWOV assumes a reduction of at least 10% in the total number of DRL-relevant accidents. Assuming this reduction and a 95% probability (of one tailed test) that this reduction will in fact be found, a statistical requirement of at least 1000 accidents percell applies. How this will affect a further division into types of accident (per year) according to collision partner and accident location (inside or outside the built up area) is illustrated in Table 1.

Collision partner	Inside b.u.a.	Outside b.u.a.	Total
fast traffic - fast traffic	4 165	3 108	7 273
fast traffic - slow traffic	12 576	2 130	14 706
Total	16 741	5 238	21 979

Table 1. Injury accidents (1988) during daylight, subdivided according to collision partner and accident location (inside or outside built up area).

Demonstrating that a verified (significant) reduction in the number of accidents can be attributed to the influence of a specific regulation depends on the degree of influence for the number of relevant or non-relevant accidents.
One could create a framework in which as many arguments as possible are proposed which together will lead to a situation where it becomes likely that the measure has contributed to the development observed. At the very least, it should demonstrate that it is an acceptable measure with respect to road safety.
Such a framework can be constructed by formulating hypotheses about various percentage reductions anticipated for certain types of accidents.
An example of a supposed hypothesis: assuming that collisions between motor-vehicle and slow traffic will fall by 15% (c) inside the built up area, and by 5% (d) outside the built up area, and assuming that collisions between motor vehicles will fall by 10% both inside (a) and outside (b) the built up area following introduction of the regulation, the following contingency tables may be constructed:

	Before the introduction				After the introduction			
	relevant		not relevant		relevant		not relevant	
	built-up area	non-built-up area	built-up area	non-built-up area	built-up area	non-built-up area	built-up area	non-built up area
f-f					a	b		
f-s					c	d		
	experimental A		control B		experimental C		control D	

Principal hypothesis: C diminishes with respect to A, B and D (interaction between the tables).
Sub-hypothesis: c (cell content) diminishes with respect to cell content a, b and d (interaction within the cells). The expected effect maybe, e.g.:

c (cell content)	approx. 15% decrease
b and a	approx. 10% decrease
d	approx. 5% decrease
Total (average)	approx. 11% decrease

When the effects differ in conformity with the hypotheses - not significantly when considered separately, except for the total number of accidents - they will still reinforce the likelihood of the explanation (= influence of the regulation).
The strength of the explanations is also dependent on the reliability and representational quality of the measured user percentages (project B).
Hypotheses must be generated from the literature (section D.a) and from theories (sections D.b and D.c).

o Additional activities
To put forward sound argumentation, the following activities would be essential, or at least desirable:

- Responsible hypothesis formulation (section D.a).
- Use of reliable control groups (sections A.a, A.b and A.c and project F).
- Registration on the accident form whether the motor vehicles involved were driving with DRL (sections A.b and project E).
- Measurement in the field of how the user percentage develops as a function of time (project B).
- Laboratory research and behavioural studies on traffic situations relevant to DRL (sections D.b and D.c).
- Asking road users what they think about DRL with regard to their own feeling of safety (section A.c and project C).

• Control groups
DRL is essentially a day-time measure. It would therefore be logical to use the accidents at night as a control group. However, it appears that for statistical reasons this group of accidents (given the absolute numbers per cell) does not allow a subdivision similar to Table 1. This complicates making statements about effects per group.

Collision partner	Inside b.u.a.	Outside b.u.a.	Total
fast traffic-fast traffic	2 023	1 094	3 117
fast traffic-slow traffic	3 464	541	4 005
Total	5 487	1 635	7 122

Table 2. Injury accidents (1988) during night-time, subdivided according to collision partner and accident location (inside or outside the built up area).

By combining several years, the restrictions related to (sub)statements can be partially compensated. In addition, other explanations for changes (whether or not disrupting the outcome) can be excluded at an earlier stage.

Aside from night accidents as control group, accident groups (such as head-tail and single-car accidents) can serve as a control group. For these groups, only a slight or entirely no effect is expected from the use of DRL.

A third way to establish a control group is by using data from accidents abroad. Taking into account geographically comparable circumstances and similar traffic situations (e.g. intersection accidents involving motor vehicles), accidents for the Federal Republic of Germany (the northern area), the west of Belgium and the north of France could be utilised. This activity demonstrates a close relationship with project F.

Methods of analysis

The conduct of a before and after study will include the years 1987 up to and including 1992. The years 1987 and 1988 will be compared with 1991 and 1992. The combination of two years may be required to achieve a statistically satisfactory number of accidents per cell for valid sub-statements. If partial use of DRL is known (project B) the years 1989 and 1990 may be used as well. The accidents are categorised according to the following types of collisions:

- passenger car - passenger car/inside or outside built-up area/weather condition/road type etc.
- motor vehicle - motor vehicle (lorries, passenger cars, motor cycles and the like)/idem

- passenger car - cyclist/moped driver/pedestrian/idem
- motor vehicle - cyclist/moped driver/pedestrian/idem

The exercises will be conducted for :
- The Netherlands (total);
- per region.

The model to be used looks as follows:

Period		1987	1988	1989	1990	1991	1992
Use of DRL (project B)		none	5%	10%	20%	60%	80%
Experimental group							
DRL relevant accidents	DRL used	X	5%X	10%X	20%X	60%X	80%X
	DRL not used		95%X	90%X	80%X	40%X	20%X
Control group							
DRL non-relevant accidents		Y	Y	Y	Y	Y	Y
Total		X+Y	X+Y	X+Y	X+Y	X+Y	X+Y

This model also shows that the strength of the (sub)statements and or conclusions depends on reliable weighted user percentages. This places stringent demands on the measurement programme, which must provide reliable user percentages for all combinations required for the accident analysis.
Therefore, the quality of the results of project A depends on the quality of the results of project B.

Aside from these contingency table analyses for the before and after study, a time series analysis will be conducted, using the multivariate ARIMA method with interventions and control groups to calculate the extent to which the regulation has been effective (Harvey & Durbin, 1986). The

ARIMA model provides a calculation method to average out the fluctuating number of accidents per season, for example.
The ARIMA model does not take into account the period of partially complience. Therefore, adaptation of the model is required to allow a sound extrapolation of an accident pattern (of types of accidents or categories of injured people, for example) based on previous accident data.
Adapting the ARIMA method will be a cost-increasing factor. If this cannot be realised due to financial considerations, it means that forceful statements about the specific effect of the DRL measure itself - based on this method - have to be qualified.
The time series analysis will include the accident data from 1982 to 1992, provided the user percentage of DRL is known.

It will be assumed that use of DRL will differ for each season and time of day. Therefore, the time series analyses will use data per time interval. The intervals are selected in such a way that the differences in use of DRL between the intervals are as great as possible, and the differences in use of DRL inside the intervals will be as small as possible.
The simultaneous time series analysis is carried out across series of accident data, differentiated according to the same characteristics that applied to the contingency table analysis (see before and after study).
If for one of the series the number of injured people per time unit is too small, then different series will be combined.

The results from these two methods of analysis should provide the answer to the question concerning the extent to which the DRL regulation will contribute to road safety at a national level.

2.2.2. Section A.b.: Restricted accident study

The registration forms will serve as information source. As already has been pointed out (par. 2.2.1), it is not possible (on a national scale) to establish a direct relationship between vehicles involved in accidents were driving DRL or not by using data from the Dutch Road Accident Records Office VOR.
It is expected that - on a limited scale - some police forces will cooperate recording this data for the duration of the study. The municipal police of Dordrecht has already agreed to co-operate (project E). Assuming

there will be sufficient response and assuming that the cooperating forces (national and metropolitan police forces) are reasonably distributed across the Netherlands (project B), this extra accident data will allow a more detailed accident analysis, to provide for specific statements.
In addition to this it is important to generate hypotheses about the anticipated reduction in the number of accidents under specific circumstances (see project D). The statistical requirement of a minimum of 1000 observations per cell may then be reduced. For example, if there is reason to assume that (under previously hypothesised circumstances) a greater reduction may be expected and the requirement that the probability of finding this will be 90%, the absolute number of observations may be reduced to approx. 400 (OECD, 1981).

In order to increase the number of accidents in the analysis, the analysis will also use damage only accidents. It is anticipated that this inclusion will increase the number of accidents for the analysis by a factor of ten or twenty.
Some disadvantages are:
- generalizations are not allowed; if there is sufficient spread of information sources, this problem can be reduced;
- if the number of observations per cell is statistically insufficient, the analyses will not lead to conclusions.
- use of registration forms implies a cost increase.

Advantages:
- a distinction can be made between cars involved in accidents driving DRL or not;
- it allows statements about damage only accidents.
- the direction of cars driving DRL or not is known. This can provide valuable information for sections D.b and D.c.

Methods of analysis
With regard to the methods of analysis to be used, section A.a has already provided a detailed description. There the central question will be:
- What is the surplus value of the extra data 'use of DRL' with regard to section A.a?

In order to answer this question, the following hypothesis is used.

Assuming that at intersections a vehicle driving DRL is less likely to be involved in an accident than a vehicle not driving DRL, and assuming that it does not matter from which direction vehicles driving DRL or not approaching intersections, the following contingency table may be constructed:

	Estimated number of vehicles (for example 60%)		Observed number of vehicles	
	using DRL	not-using DRL	using DRL	not-using DRL
Motor vehicles using DRL	36%	24%	22%	y%
Motor vehicles not-using DRL	24%	16%	x%	30%
	X		Y	

X = expected cell distribution;

Y = actual cell distribution (from registration forms)

This example illustrates which kind of analyses can be carried out if the data (use of DRL) is added to the registration form by the police. Here, reliability is a main condition for using this data. Therefore it must be established to what extent the police are able to record use of DRL.
In other words, with the aid of the measured DRL percentages (project B), expected distributions can be determined. Subsequently, the estimated number can be compared with the actual observations.
Here, too, the various options for the control groups will be included in the analysis (see par. 2.2.1).
The model is used for:

<u>Types of collision</u>

- intersection accidents, involving motor vehicle only and motor-vehicle versus slow traffic; if there is a sufficient number per cell, variables with respect to weather, built up or non-built up area and the like may be included;
- head-on collisions, idem;
- head-tail collisions, idem.

Collision partners

Analyses will also be conducted into:

- passenger cars versus moped drivers, cyclists and pedestrians;
- all motor vehicles versus moped drivers, cyclists and pedestrians.

The results from this section may also provide an answer to the question on the extent to which the use of DRL contributes to a reduced probability of involvement in specific types of accident.

2.2.3. Section A.c.: Fleet-owner studies

The realisation of these studies depends on whether:

- there are fleet-owners in the Netherlands whose car fleets are sufficiently large to conduct proper analyses.

Suitable car fleets would be those of the Ministry of Defence, or the combined car fleets of all Ministries, the PTT (Dutch Telecom) car fleet, and the like.

This co-operation of a fleet-owner 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 co-operation has an advantage over the second. Disadvantage: This can only be done while DRL is not obligatory. 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. Alternative: a comparison with similar fleets without DRL.

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 for estimating nation-wide effects, 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.

The added value of fleet-owner studies provides an insight into and/or information about:

- how drivers experience the increase in use of DRL as a function of time, and if an increasing number of DRL users will influence the pattern of accidents of this group.

This information can link up with, or provide, information about sections D.b and D.c. Conversely, hypotheses can be generated from project D and tested at micro-level.

- The accident history and driving experience of drivers involved is known.
- Experiences gained in practice with technical aids and concerning the cost aspect can be included in project G and project H.
- An international comparison between Dutch fleet owner studies by other studies abroad can be carried out (project F).
- Experience data of feelings of safety versus feelings of danger in relation to the use of DRL can be compared with data from project C, can reinforce statements based on the results of project C.

Furthermore, fleet owner studies provide extra arguments to support the results of sections A.a and A.b., and facilitate the interpretation of the results of the accident studies in terms of cost-benefit (project H).

3. PROJECT B: EVALUATION: USE OF DRL

3.1. Introduction

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 defect lamps 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, by means of a small survey conducted at car workshops and/or the Royal Dutch Touring club ANWB. This factor can also be included in the survey associated with project C.

3.2. Approach and realisation

3.2.1. General

In order to provide a reliable user percentage at a national level, measurements must be carried out at a great number of locations and under all conditions. However, for both practically and/or economically this is not feasible.
Therefore, a national measurement programme has been designed, including the most important factors of influence. These factors are:

- provincial differences: four classes (regional);
- urbanisation level: built up area: three classes <30 000, between 30 000 and 100 000 and >100 000.
- type of road: motorways, trunk roads and main highways (differentiated according to speed limit: 100-80 km and roads inside the built up area (= 50 km roads);
- six time periods per day: one half hour before sunrise up to morning rush hour, morning rush hour, rest of the morning, afternoon, evening rush hour and up to one half hour following sunset;
- months;
- weather condition in two classes: dry and rain;
- light conditions;
- traffic density;
- weekdays versus weekends

In other words, measurement locations must be nation-wide across the Netherlands, time-periods per measurement location per day must be spread out over the day and the scope of the observations per time-period must be (statistically) large enough. Therefore, every time-period 200 cars will be counted; if the amount of vehicles is low the maximum time-period will be one hour. The illumination levels will be measured every five minutes during each time-period.
In order to meet these requirements, a maximum of 48 time-periods at six locations per region per month will be carried out. The aim of analysing the results yearly is to establish whether the assumptions about the differences in use of DRL are justified or not. If a number of assumed differences do not occur, a number of measurement locations can be dropped.
The measurements can be supplemented at several points in time with a few measurements at locations which have not been included in the sample (e.g. small villages, rural roads and the like). It is not expected that use on these types of road will differ greatly from use of DRL at the other measurement locations. If this assumption is justified, these measurements need not be considered any further.

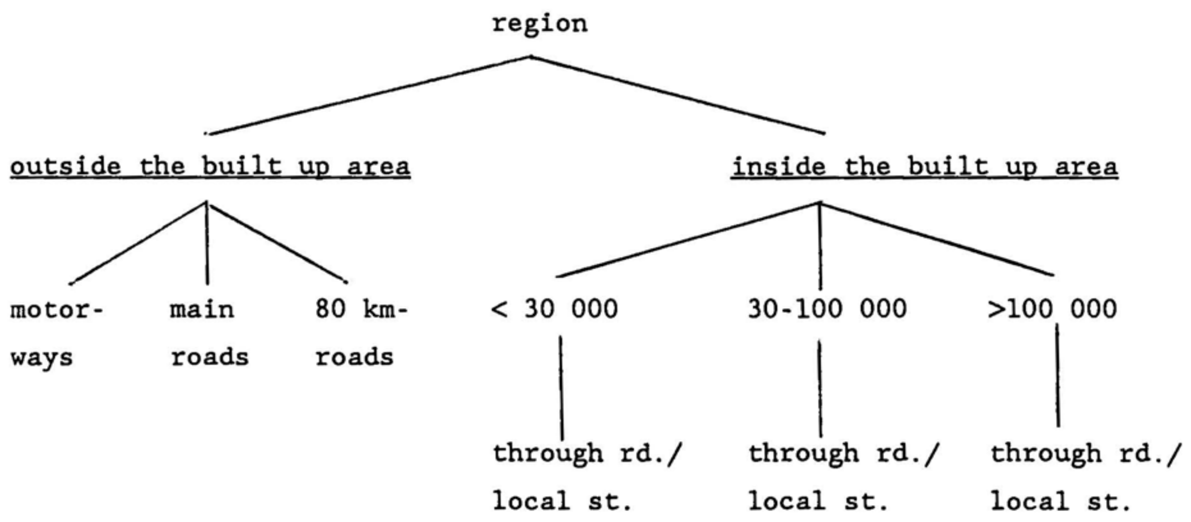
3.2.2. Distribution across the Netherlands

Due to the population composition and distribution according to traffic composition and traffic density, it is advisable to divide the Netherlands into four regions. Furthermore, the first national measurement of DRL use in 1988 showed that differences for various parts of the Netherlands can be anticipated. This has led to the selection of the following four regions:

- region 1: Friesland, Groningen and Drenthe
- region 2: Overijssel, Gelderland and Flevoland
- region 3: North Holland, South Holland and Utrecht
- region 4: Zeeland, North Brabant and Limburg

From the distribution of accidents according to whether they were inside or outside the built up area, it is essential to take the built up area into account for each region. In order to relate user percentages to accidents, it is desirable to distinguish between motorways, trunk roads and 80 km main roads outside the built up area (section A.a).

A through road is selected inside the built up area. The location on this road is chosen such that it will intersect with a local street.
In order to take into account the urbanisation level (which is again determined by the size of the cities), a distinction will be made between cities of more than 100 000 inhabitants, cities of between 30 000 and 100 000 inhabitants and cities of less than 30 0000 inhabitants.
As the city of Dordrecht has been included in the overall project as demonstration project, it will be included in the national measurement (see project E) as one of the large cities as well (region 3).
Measurements will be taken throughout the year, and will include a number of weekends.
This gives a schematic representation per region as follows:



3.2.3. Spread over the day

Accident peaks between motor vehicles especially coincide with morning and evening peak traffic (= commuter traffic), and to a lesser extent in the afternoon. Slow traffic (particularly pedestrians) shows a different accident pattern as compared to motor vehicles; the 'peaks' are less variant. Therefore, it has been decided to establish user percentage in the measurement programme on the basis of six daily periods.

3.2.4. Data collection

The data collection consists of:

- passenger cars with and without DRL;
- lorry traffic, motor cycles and moped riders (it is assumed that moped riders will be influenced by the DRL measure and will also use daytime lights more often. If this proves to be true, then knowledge on this matter is essential for the interpretation of accident analyses; per measurement location, if relevant, at least ten mopeds will be counted);
- all motorway traffic lanes in one direction will be separately measured (the measurement results for 1988 show a difference in use of DRL per traffic lane).

Other data to be noted:

- illumination level;
- weather condition (dry, cloudy or rain);
- condition of the road surface (dry or wet);
- visibility (how far can a driver look ahead?; this demands a subjective decision on the part of the person counting);
- time when public lighting was switched on or off (where relevant).

In order to calculate reliable user percentages for all factors of influence, high demands must be set for the quality of the data to be collected. A plan will have to be drawn up to conduct sample checks, which involves extra costs.

4. PROJECT C: EVALUATION: PUBLIC ACCEPTANCE

4.1. Introduction

Compliance with regulations increases as road users become better informed and understand the reason for the regulation more clearly and agree with it. 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 car owners' willingness to purchase technical aids, 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. These 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 for drivers to adhere less strictly to the DRL regulation.
- To identify side effects and monitor their development. 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 study, 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 start of the information campaigns.
- The second measurement will take place following the main 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.

It is estimated that the sample size needs to be at least 1200 to 1500 people per target group - depending on the question to be asked and the required accuracy of the result - providing the sample has been carefully stratified. For the planning and set-up of the survey, experiences gained in the municipality of Dordrecht will be utilised (the relationship between project C and project E).

4.2. Aim and methods

If the road user is convinced that a regulation will contribute to his or her safety, the compliance percentage will be very high (Lindeijer, 1988). In that case the government does not need to invest much on information campaigns to persuade the public about the usefulness of the regulation. Efforts of police enforcement can be kept to a minimum. However, this is not so for regulations which do not satisfy this criterium like e.g. regulations for which the road user does not understand its uses. If people are not fully aware (or are not aware at all) of the safety benefit of a regulation and complying with such a rule means to them pushing up the costs, complience with such a regulation will be limited. Investigation into this process will provide a clear insight into the question of "how effectively" DRL works in terms of social benefit and approval with regard to traffic safety.

There seems to be few regulation in the area of traffic safety from which one could expect a national accident reduction of approximately 5%, provided the regulation is practically fully complied with. If a reduction of 5% would indeed be realised, it could amount to a cost-saving factor of over 200 million Dutch guilders annually (NPV II, 1985). In order to make the DRL regulation as effective as possible, the government must go to great lengths in terms of financing:

- information campaigns;
- specific campaigns by police enforcement;
- local information campaigns, aimed at target groups (specific campaigns).

Therefore, it will be essential to investigate the extent to which these actually contribute to an increase in the compliance percentage with DRL. A sound cost-benefit analysis can only be carried out if such data is available (project H).
Aside from increasing motivation, the government must be able to deal with possible <u>side effects</u> like decreasing mobility certain social groups. Therefore, it is necessary to conduct a study into public acceptance. As already has been pointed out in par. 4.1, the results from this project will make a worthwhile contribution to a number of other projects.

4.3. <u>Set-up and approach</u>

A preliminary study conducted in Austria on the acceptance level of use of DRL indicates that approval is greater in the 25 to 45-year age group than in other age groups. It also indicates that the number of years one has had a driving licence is an important factor - the study showed that the acceptance level correlates with the duration of the driving licence. People who had a driving licence for at least 7 years to a maximum of 15 years scored high on the acceptance level. In addition, a significantly higher acceptance level was measured for lorry drivers and women (Verkehrspsychologischer Informationsdienst, 1989).
This preliminary study dealt with a restricted group which did not constitute a national cross-section. However, it does give the suggestion that one will need to take into account target groups with different attitudes towards the regulation. So, information campaigns aimed at different target groups will be more effective than one great national campaign.
It is expected that the Preliminary study (section D.a) will provide more reliable information to enable proper differentiation between target groups.

Research methods to investigate acceptance levels and attitudes are called opinion polls. Depending on the target to be measured, the study will use mailed questionnaires or interview techniques.
The aim of the study is to assess the sensitivity towards information campaigns and/or police enforcement within each group and between groups (e.g. driving licence owners according to gender, bicycle riders, moped riders, lorry drivers and the elderly, etc.).
These results will provide detailed information to what extent people receive the DRL-"message", they will provide information for a sound cost-benefit analysis (project H). As mentioned before (par. 4.1) each random survey must contain at least 1300 respondents, provided they are all accurately weighted.

4.4. Processing the data

Opinion polls can be very expensive. Therefore several techniques will be used, e.g.:

- A survey (using structured questionnaires) will be carried out to measure the acceptance level to buy technical aids and, if possible, to gather information from people already using technical aids.
- To gather information of a presumed reduction in mobility for the elderly it would be advisable to participate in the biennial study of the lifestyle of the elderly.

To measure the efficacy of information campaigns and police control a semi-structured questionnaire will have to be designed. The questionnaires to be used will be tested on reliability and validity, otherwise well-founded statements will not be possible in relation to various topics.

The results of the surveys have to be analysed as soon as possible, because the results are required in order to provide the government with timely information on:

- progress of the acceptance level (national and per target group);
- the development of negative motivations;
- the effect of information campaigns;
- the feeling of mobility restriction arising in certain social groups;
- how the number of users of technical aids is progressing. (This information is important because it has a bearing on the interpre-

tation of user percentage). Will people with an automatic switch change their driving behaviour? (information needed to interpret the results of sections A.a and A.b). Negative experiences with technical aids can also supply information for project G;

- how people experience police controls with respect to this regulation and how police control contributes (or does not contribute) to the increase in user percentage;
- problems experienced by road users in relation to the use of DRL. For example, motorcycle riders and slow traffic.

The analysis will investigate the development of sensitivity with respect to information campaigns and/or police controls for each target group.
In addition, the analysis will enable statements on the difference in sensitivity between the target groups.
Data from this project can provide valuable information on the process of a decreasing use of DRL for project H (cost-benefit analysis) and will provide information for the theoretical study as well (sections D.b and D.c).
On completion of the last opinion poll, an overall analysis will be conducted. Based on this analysis, a comprehensive process description as a function of time can be given.

5. PROJECT D: THEORETICAL INTERPRETATION

5.1. Introduction

There is sufficient confidence that DRL will help to improve road safety in the Netherlands. The extent of this contribution (i.e. the reduction in the number of accidents) and the explanation for the efficacy of DRL are less certain.
For organisational reasons 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. Review of the literature.
b. Theoretical study (experimental research in a laboratory setting).
c. Behavioural observations (= optional field study).

Review of the literature (section D.a) will include a supplementary study of the literature, which will examine in particular the most recent international study results (from 1985 onwards). The aim of this literature 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 in matters relating to DRL and what has not and is necessary and feasible on these matters?
- Study of behaviour (section D.c): what has been studied in matters relating to the use of DRL and what has not and is necessary and feasible on these matters?

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 (experimental 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).

5.2. Approach and realisation

The previous paragraph explained that many countries are convinced that DRL would benefit traffic safety. However, DRL can only help to make the vehicle 'visible' to others. Therefore the following questions are central to this project:

- What can DRL add to the visual traffic information that is not already achieved by daylight (= problem of visual selection?).
- What influence can DRL have, given this visual selection, on traffic safety?

5.2.1. Section D.a.: Review of the literature

The literature studied until now relates to the years prior to 1986. Since then, several studies have been initiated, executed and/or reported on, and progress has been made in the field of theory formulation.
In order to ensure that studies will not be conducted that have already led to results elsewhere, it is useful to conduct an additional literature study to collect and study newly obtained knowledge. New information must then be compared with already existing information, to establish whether conclusions drawn at the time must be adjusted or supplemented.

Based on this literature study, hypotheses may then be generated which will provide the input for projects A, B, C and D.

It has been decided to conduct the literature study in close association with the Dutch Institute for Perception (IZF-TNO).
Both the IZF and the SWOV are convinced that a positive outcome may be anticipated from the use of DRL. However, there are differences of opinion concerning both the basis on, as well as the extent to which a positive effect may be expected. Furthermore, the IZF-TNO is already conducting experimental research (under laboratory conditions) on 'visual selection' under the commission of the SWOV. The advantage to arrive at joint hypotheses includes:

- a number of questions under study can be included in the existing study programme 'Visual selection';
- duplication studying the effect of using DRL will be avoided.

5.2.2. Section D.b.: Laboratory studies

The only difference between the situation with and without DRL is the 'light intensity' factor, or more correctly 'contrast'.
When observing (visual) elements, a distinction is often made between concepts such as detectability, visibility and recognisability. Particularly the concept 'recognisability' is of essential importance, as well as other cognitive aspects of observation. More is known about the physiologics and psycho-physics (e.g. detectability) of the visual system than about the cognitive aspects. Little is known about the observation and recognition of moving objects of dynamic images in complex situations and the visibility and recognisability of static images in particular.
A step-by-step approach has been chosen for the study under experimental conditions in the laboratory and in the field. Almost all the experiments to be conducted place the emphasis on the cognitive aspects of observation.

First, a laboratory study will be conducted into the contrast effect in relation to the recognition and identification of visually presented elements. Variables that are considered to play a role in this (namely: contrast effect - initially for statically presented images - against a background under variable illumination and adaptation through habituation)

will be varied under controlled conditions. This will lead to a 'pure' picture of the effect on recognition level (and thus not only detection). The disadvantage is that the result cannot be directly translated into practice, but they provide hypotheses necessary to initiate a well-founded study into other cognitive aspects.
In order to formulate a well-founded hypothesis, a number of experiments must be conducted. These series of experiments must be regarded as an integrated whole. From considerations of economy, several experiments will be conducted by the SWOV in collaboration with Leyden State University (RUL).
Where possible, other required experiments (with emphasis on the dynamic aspect of the contrast effect) will be fitted into existing studies conducted at the IZF-TNO on 'visual selection' and/or in collaboration with the Leyden State University.

For the second part of the laboratory study, video pictures of traffic situations can be compiled on the basis of the generated hypotheses. Four main experiments will be conducted using these video pictures. The experiments will relate to:

- selective attention (these experiments will also test the hypotheses from the first part of the laboratory study);
- identification (here, too, there is question of testing the hypotheses from the first part);
- estimation of distance (new activity);
- estimation of speed/anticipating direction/estimation of risk (new activity).

The disadvantage will still be the limitations regarding the translation of results to the actual situation. The advantage will be that simulated traffic situations are already being worked on. This will allow translation to actual situations, thereby providing hypotheses for experiments in the field.

The experiments in the field will be directed towards behavioural aspects. Dependent on the feasibility of performing the laboratory experiments inside the time given, they will focus entirely on testing the hypotheses. In addition, the following points will be looked at during experiments in the field (under controlled conditions):

- gap acceptance;
- reaction time;
- strength and quality of the reaction;
- risk estimation and acceptance.

The laboratory study will first focus on the likelihood that DRL makes the visual task more easy. In addition, it will examine to what extent the traffic task is linked with the manner of traffic participation and/or whether DRL could have a disruptive effect on other parts of the traffic task.

5.2.3. Section D.c.: Behavioural observations

On approaching an intersection, a driver is confronted by a great deal of information, from which relevant information must be selected. It is anticipated that the use of DRL will 'clarify' the recognisability of relevant information. This would then lead to a more adequate reaction and to a shorter reaction time, so that conflicts will either be prevented or the severity of a collision will be reduced.
The study will make use of video recording before and after introduction (with and without DRL) from actual observation.
These studies are costly, but may be partially (under some conditions) fitted into the integrated study on the relationship between accidents and traffic behaviour at intersections (Project 6 of the SWOV Long Term Study Plan). This study proposal has been put forward to a new international group (yet to be set up) concerned with 'Road accident risks'. It is an enterprise from TRRL and SWOV (see project F).
Another international study into intersection observations which is ready to commence (co-operation between the Federal Republic of Germany and the United Kingdom) could also offer possibilities (see project F).

It is expected that on the basis of results from laboratory, field and behavioural studies, explanations can be proposed as to what extent approaching situations of conflict may be avoided or reduced by the use of DRL; statements can be made about a reduction in risk through application of DRL.

6. PROJECT E: DEMONSTRATION PROJECT DORDRECHT

6.1. Introduction

In the context of the Dutch Safety 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).

6.2. Approach and realisation

As the people of Dordrecht have been previously confronted by a DRL campaign, it was decided to run this project as a control group for the national evaluation study. In this way, the holding user measurements will be incorporated into the national measurement programme (project B), while surveys will be included in project C as well.

Until now Dordrecht has been the only city where the police will record use of DRL on the registration form as from the end of 1989; this will require separate processing, analysis and reporting for that year. The method of analysis considered is described in section A.b. The analysis will be regarded as a pilot study with respect to the nature, scope and type of information which may be acquired from the police, and to what extent analyses of the data allowed statistically (information for Section A.b).

The DRL campaigns planned by the municipality of Dordrecht will commence in the autumn of 1989. Information campaigns will form part of this, as well as various technical aids built into the municipal car fleet. In this way, the practicability of technical aids will be investigated. Preliminary information on the technical study, the selection, variations in the use of different types of technical aids and the like will be used for project G. As these activities should provide valuable information, the SWOV will guide these developments.

7. PROJECT F: INTERNATIONAL GUIDANCE FOR THE DUTCH STUDY

7.1. Introduction

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.

7.2. Approach and realisation

There are various activities and/or studies being undertaken or planned abroad. A number of them offer an opportunity to allow parts of this study to 'tag along', for example project C (Austria) and sections D.b and D.c (Federal Republic of Germany, United Kingdom, Belgium and in the OECD).
It is also the intention to request the co-operation of foreign institutes such as the BASt, TRRL, OECD, as well as institutes for road safety research in Belgium and Denmark in conducting an international accident comparison for accidents relevant to DRL (see project A).

In concrete terms, the following subjects are under consideration:
1. Behavioural observations at intersections (project A and project B), which is being undertaken at the initiative of the Federal Republic of Germany and the United Kingdom.

For the coming study period, the BASt has planned a joint project between the Federal Republic and the United Kingdom to examine behaviour at intersections outside the built up area. The study aims to examine the behaviour of drivers at comparable intersections in these two countries. A third observation group in the Netherlands could link up with this project, introducing the use (or non-use) of DRL as supplementary variable (Section D.c). This would provide an interesting comparison and as such contribute added value to the arguments for the effect of DRL.

2. Also with regard to Project 6 of the SWOV Long Term Study Plan, a link-up on an international scale could be attempted. In this way, the TRRL (UK) and the SWOV have introduced a proposal for an integrated study into the relationship between accidents and traffic behaviour at intersections to a new international group (to be set up) concerned with 'Road accident risks' (section D.c).

3. At the end of 1989, Canada will introduce the DRL measure in a technical sense. The introduction will be carried out gradually, which means that it will be compulsory for all new cars to be fitted with automatic ignition of lights when driving off. In order to evaluate the effect of this measure, a two to three year evaluation programme has been designed. The programme will consist of:

- measuring the use of DRL;
- accident study;
- behavioural observations;
- comparison of USA accidents with those in Canada.

Canada will use analysis methods similar to the Netherlands for their evaluation study (e.g. ARIMA). It will be attempted to conduct the analyses in such a way that comparison with the Canadian results will be possible. The study in Canada will cover the periods of 1990/1991 and 1993/1994.

4. Motorbike clubs in the United Kingdom and/or the Federal Republic of Germany will be approached to form a control group for specific motorcycle accidents.

5. It will be assessed to what extent theoretical studies are being conducted into the effect of DRL in the United States. Contact is made with the Insurance Institute for Highway Safety.

Other activities forming part of this project are:

- translations (English and French) for the international committee;
- attending meetings held by the international committee;
- establishing and maintaining contact with countries abroad with regard to study activities.

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

8.1. Introduction

Among other things, willingness to comply with the DRL-regulation will depend on the efforts of road users to instal technical aids for instance. 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).

Tentative discussions 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).

8.2. Approach and realisation

Aspects which must be evaluated include:
- Increased running costs with DRL:
  - extra fuel costs;

  - extra costs from wear and tear of lamps, batteries, alternators, and the like;
  - consequences for the environment (information of section A.c and project C).
- Reliability of technical aids (see project E), such as:
  - automatic lighting on/off with starting/stopping with/without time interval (automatic switch);
  - developing a special DRL light (information from section D.b), pros and cons in terms of cost, for example;
  - visual or audio signal when starting/stopping (warning devices).
- Evaluation of driver problems using DRL (see project C), such as:
  - empty battery if the light is accidentally left on;
  - defect lamps at night (see project B).
- Use and ease of various types of technical aids purchased. This aspect must be measured in fleet owner studies (see project E and section A.c).
- Potential overloading of the electrical circuit in buses (according to the experience in Austria).

It is the intention that the SWOV will work in co-operation with industry and research institutes concerning several parts of this project.

9. PROJECT H: COST-BENEFIT ANALYSIS AND REPORTING

9.1. Introduction

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.

9.2. Approach and realisation

The activities for the progress report and the final report are adequately described in par. 9.1. Therefore, only the cost-benefit analysis will be dealt with in greater detail here.

9.2.1 Evaluation ex post of the regulation in the Netherlands

The last phase of the evaluation into the use and effect of DRL will allow comparison between the invested costs of the regulation and the effects achieved.
All costs and effects must be described for this calculation as far as possible. These will consist of:

- Costs
- Individual costs (information for section A.c and projects C, E and G):
  - extra light consumption;
  - extra fuel consumption;
  - extra batteries, alternators or other wear and tear.
- Government investments (information from all projects):
  - extra police efforts;
  - costs of the evaluation study;
  - costs of information campaigns;
  - development costs for technical aids and the like.
- Effects
  - the reduction in the number of accidents categorised according to various items (project A, intended effects);
  - possible (positive or negative) side effects (section A.c and project C).

The analysis will consist of two calculation methods:

- Cost-effectiveness

Here, costs associated with the DRL regulation will be calculated (= economic cost calculation) and expressed in terms of the number of accidents avoided as well as any side effects. If possible, the result of this analysis will be compared with other cost-effectiveness data (costs associated with improving the infrastructure, for example).

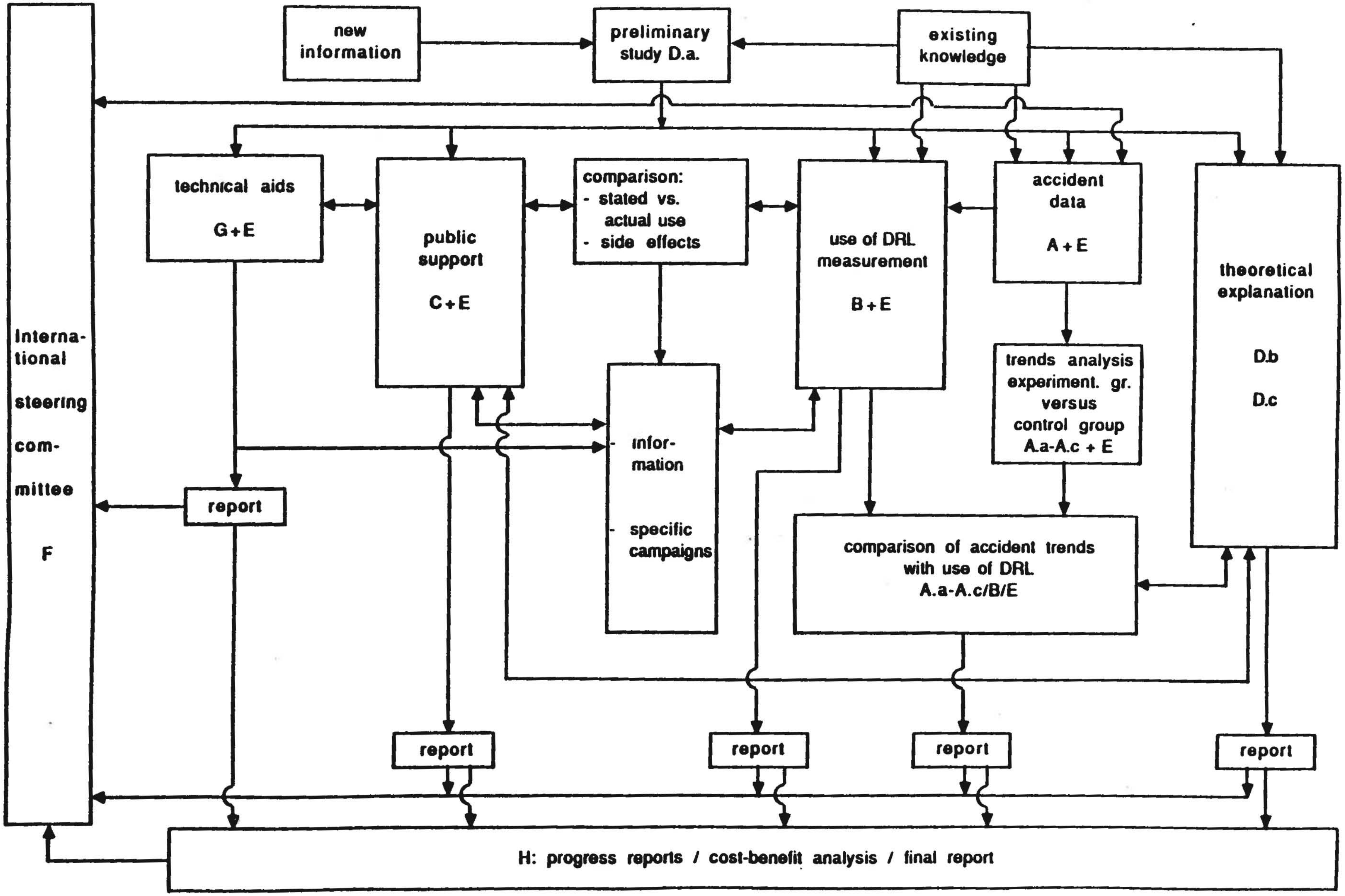
- Cost-benefit

Here, the benefits (= the number of accidents avoided as well as any side effects) associated with the DRL regulation will be converted to monetary terms. Obviously, there is an ethical problem associated with this analysis. There are also problems expected in expressing side effects in monetary terms. If an acceptable alternative is not found, however, this method of analysis will still be generally applied. Here, too, it is applicable that if data is available on the cost-benefit of other traffic safety regulations, this will offer opportunities for comparison.

9.2.2. Evaluation ex ante of the regulation for international purposes

In an international context, the principal question will be whether motor vehicles must be fitted with special devices. Using the Dutch data supplemented with other material, an estimation of costs and effects to be expected from such a regulation will be calculated for a number of the countries involved.

10. SCHEMATIC OVERVIEW OF THE RELATIONSHIP BETWEEN PROJECTS



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