Cost-effectiveness of a sustainably safe road traffic system in The Netherlands

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Contribution to the European seminar 'Cost-effectiveness of road safety work and measures', Luxembourg, November 26-27, 1997

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Summary

The Dutch Government has set the following quantitative targets for road safety: a 25 per cent reduction in the number of road deaths and injuries by the year 2000 (compared with 1985 levels) and a further reduction of 50% and 40% respectively by the year 2010 (compared with 1986 levels).
Various indicators suggest that road safety in The Netherlands is not showing enough significant signs of improvement and it is no longer certain that the aforementioned targets will be met, even if the traditional policy continued to be followed.

New, innovative road safety policy is required and in 1990 SWOV Institute for Road Safety Research was invited by the Dutch Government to develop a scientifically supported, long term concept of a considerably safer road traffic system. The general concept of sustainable development introduced by the UN Brundtland Commission also inspired the new vision for road safety: no longer do we want to hand over a road traffic system to the next generation in which we have to accept that road transport inevitably causes thousands of deaths and ten thousands of injuries, year after year in The Netherlands.
A sustainably safe road traffic system is one in which the road infrastructure has been adapted to the limitations of human capacity through proper road design, in which vehicles are technically equipped to simplify driving and to give all possible protection to vulnerable human beings, and in which road users have been properly educated, informed, and, where necessary, deterred from undesirable or dangerous behaviour. Man should be the reference standard and road safety problems should be tackled at its roots.

Safety principles were identified as keys to arrive at a sustainably safe system (functional use of the road network, homogeneous use en predictable use) and based on these principles as a basically theoretical perspective the concept has been worked out.

Stimulated by a discussion in the Dutch Parliament, the concept of sustainable road safety has been adopted by the Dutch Government as an official part of its policy. Many other stake-holders supported the concept (other governmental levels and the 'road safety community'), although some doubts have been heard about financing the implementation and about possible side-effects. Furthermore, some differences how to translate the vision practically could be detected between road safety professionals.

Two major developments took place since the concept was launched.
A special Steering Committee prepared a so-called Start-up Programme covering the first phase of implementation.
Another important step was to implement different large scale demonstration projects in The Netherlands in order to enlarge our practical knowledge and experience on how sustainable road safety may be put into practice.

Estimates have been made to investigate what the introduction of a sustainably safe traffic system would cost. The first SWOV-estimations resulted in 60 billion Dutch guilders; a major proportion of this money should be invested in adapting the existing road infrastructure according to the principles of sustainable safety. Based on different recent and more detailed estimations, a more sober implementation would cost 30 billion

Dutch guilders. SWOV has suggested to spread these investments over a period of 30 years in order to run these investments in parallel with the standard maintenance of the road infrastructure; a period of 30 years is a reasonable one for the Dutch circumstances.

If we invest 30 billion Dutch guilders over a period of 30 years, we estimate a reduction of 60% of the number of road accident casualties. Even if we use a conservative basis for cost-effectiveness estimations, SWOV concludes a cost-effectiveness of 9%, which is considerably higher than the customary government standard of a 4% return on investment for infrastructure projects.
The key stakeholder to realise a sustainably safe road traffic system is the government, either directly as investor or indirectly as 'broker' between those who could invest and those who profit from the benefits.

Contents

1.	*Road safety in The Netherlands*	6
2.	*Sustainable safety*	9
2.1.	The concept of sustainable safety	9
2.2.	Start-up programme on sustainable safety	10
2.3.	Demonstration projects	11
3.	*Costs and benefits of sustainable safety*	14
3.1.	The total costs of traffic accidents	14
3.2.	The costs and the effects of a sustainably safe systems	15
3.3.	Financing a sustainably safe road transport system and the benefits for society	16

1. Road safety in The Netherlands

Without hesitation we may assess that The Netherlands fits in the group of countries in the North-western part of Europe (United Kingdom, Sweden, Norway, Finland) which has a relatively good safety record. The most recent figures (1180 fatalities in 1996) leading to a mortality rate of 7.6 could partly bridge the gap between The Netherlands and the 'real top'.

Another interesting perspective is the development of the number of fatalities over time.

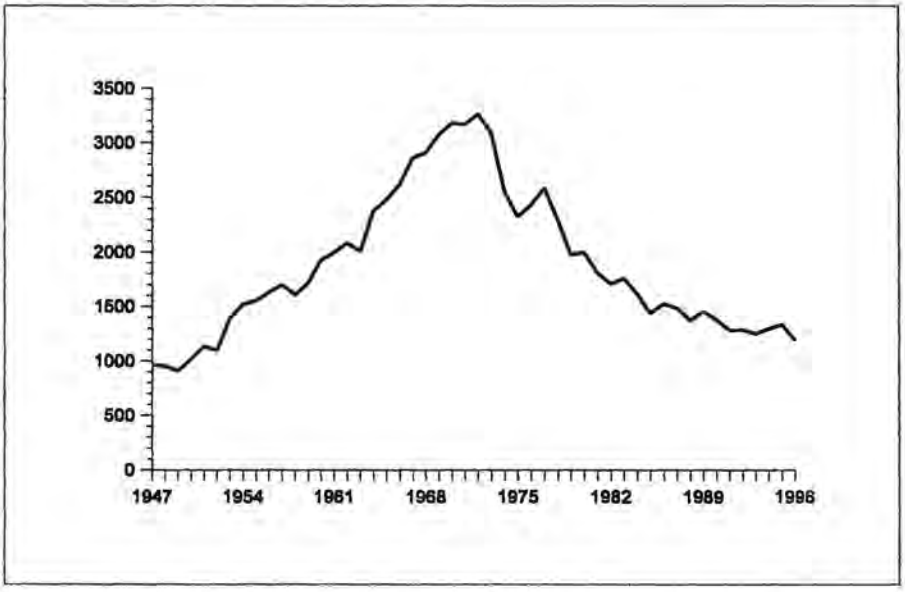

Figure 1. *Development of fatal accident numbers in The Netherlands.*

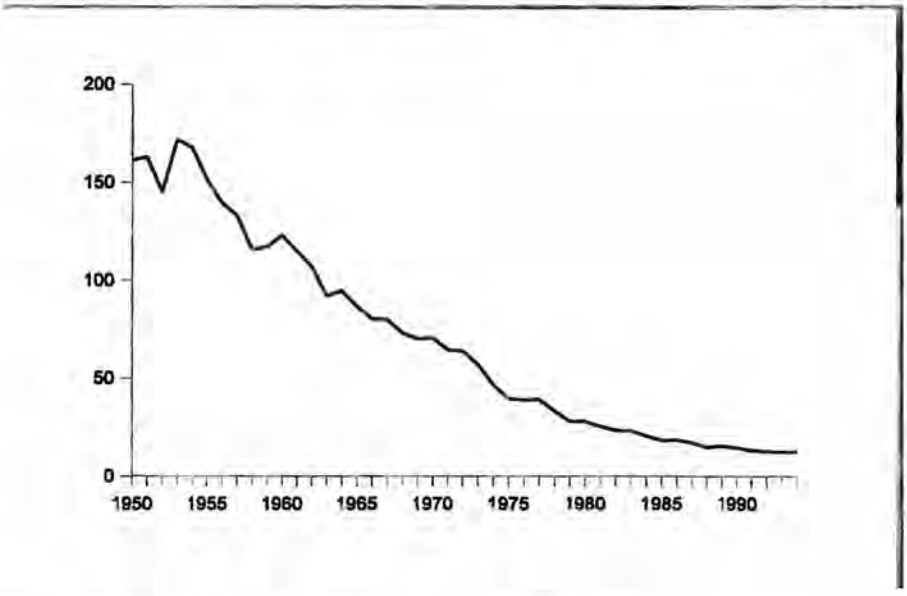

Figure 2. *Risk development (fatalities/vehicle kilometres) in The Netherlands.*

In the long term, the growth of motorisation in many countries is accompanied by an decreasing curve for fatality rates. The percent decline per year differs from one year to the next and per country.
Figure 1 illustrates the development of the number of fatalities in The Netherlands over the years and *Figure 2* shows the reduction in fatality rates in The Netherlands.
We may conclude that from an all-time high in 1972 (3264 fatalities) the numbers reduced to about 1200 fatalities a year. But, we have to conclude that the fatality rate reductions have come down from something like 9% (1973-1985) to 2.5% (1992-1995). Combined with the mobility growth of about 3% makes it understandable that the number of fatalities remained more or less constant in The Netherlands the last few years.

"The price we pay for our mobility is still much too high." This statement could be found in the most recent formal document from the Dutch Government on road safety (Ministry of Transport, Public Works and Water Management, 1996a). In this document no new vision for road safety policy is developed, but the existing one is pursued to date. To characterise the Dutch road safety policy in a few words, the following one-liners could be given:
- quantitative road safety targets for the year 2000 and 2010;
- a spearhead policy: alcohol, safety devices as seat belts and helmets, speeding, hazardous situations, older and younger road users, heavy traffic);
- emphasis on the importance of involving provinces, municipalities and market parties in road safety policies;
- developing and implementing a sustainably safe road traffic system.

The Dutch Government has set the following quantitative targets for road safety: a 25 per cent reduction in the number of road deaths and injuries by the year 2000 (compared with 1985 levels) and a further reduction of 50% and 40% respectively by the year 2010 (compared with 1986 levels). Recent indications suggest that road safety in The Netherlands is not showing enough significant signs of improvement and it is no longer certain that the aforementioned targets will be met, even if the traditional policy continued to be followed (SWOV, 1996).

In a recent survey (Ministry of Transport, Public Works and Water Management, 1996a) amongst key stakeholders a picture was given how the implementation of policy can be improved and how the partners can contribute to this. The following picture was given:
- increasing mobility demands additional efforts to achieve road safety targets;
- concern exists about deteriorating road user behaviour and reduced levels of traffic law enforcement;
- implementation of sustainably safe road transport ask for more financial means, better understanding of the concept and more integration with environmental planning and general safety policy;
- decentralisation of road safety policies needs to further crystallise and the parties still have to become accustomed to their new role;
- development and dissemination of relevant information on road safety policies need to be improved.

SWOV made an analysis of recent developments in the field of road safety policies as well and came up with some recommendations as to what can be

done, now and in the future and how it can be done (SWOV, 1996). It is interesting to note that in recent years, a number of important factors of influence on road safety (driving under the influence, wearing seat belts, speeding behaviour) have sooner tended towards deterioration, rather than improvement. In addition, no major successes have been registered of late with regard to measures that have managed to reduce road hazard to a considerable degree. Finally, social interest in road safety problems seems to have diminished somewhat as has (also in relation to this attitude) political and policy concern. This does not mean, however, that the disappointing developments in the field of road hazard are thereby easily explained. However, all these tendencies seem to point in the direction of stagnation.

SWOV has recommended a strategy to be adopted consisting of three parts:

- A number of effective measures should be taken in the short term, focusing particularly on the already formulated spearheads of policy that should result in the goals set for the year 2000 being accomplished. The most effective approach appears to be to strengthen police enforcement - placed in a context of large scale information campaigns with the participation of the mass media (Wegman & Goldenbeld, 1996).
- It should be ensured that road safety considerations are explicitly included and weighed at all levels of the decision making process affecting road safety - national, regional and local - particularly in the field concerning mobility and the infrastructure.
- The results and, hopefully, the successes of implementation of the first and the second recommendation should be utilised to realise a sustainably safe road traffic system, step by step, over a longer period of time.

2. Sustainable safety

2.1. The concept of sustainable safety

The starting point of the concept of 'sustainable safety' is to drastically reduce the probability of accidents in advance, by means of infrastructure design and, where accidents still occur, the process which determines the severity of these accidents should be influenced so that serious injury is virtually excluded (Koornstra, et al., 1990 and Ministry of Transport, Public Works and Water Management, 1996b).

The concept is based on the principle that man is the reference standard. A sustainably safe traffic system has an infrastructure that is adapted to the limitations of human capacity through proper road design, vehicles fitted with ways to simplify the tasks of man and constructed to protect the vulnerable human being as effectively as possible, and a road user who is adequately educated, informed and, where necessary, controlled.

The key to arrive at a sustainably safe road system lies in the systematic and consistent application of three safety principles:

- functional use of the road network by preventing unintended use of roads;
- homogeneous use by preventing large differences in vehicle speed, mass and direction;
- predictable use, thus preventing uncertainties amongst road users, by enhancing the predictability of the road's course and the behaviour of other road users.

In a sustainably safe road traffic system, the *road user* represents the central element, the reference. He must be prepared to accept an infrastructure, vehicles, rules of behaviour, information and control systems, that may restrict his individual freedom, in return for a higher level of safety. If this willingness is not present, resistance will result. Perhaps by using 'social marketing' the willingness to accept all elements could be achieved. Freedom restrictions without good arguments should not be offered to the road user.

Education could and should play an important role in the transition period from the road traffic system of today to the sustainably safe system. The content of education could concentrate on the whys and wherefores of sustainable safety. Public awareness, public participation and education should create support for implementation and find their place alongside implementation of other key elements of this vision.

With respect to *vehicles*, the diversity of vehicles should be kept to a minimum. Furthermore, the various types should be clearly distinguished. When used in the same traffic area, vehicles should demonstrate the same behaviour as far as possible, or otherwise be provided with separate facilities. In the sphere of passive safety sustainable provisions to be mentioned here are those that work independently of the driver or the passenger: 'built-in' devices like solid passenger compartments of cars combined with crushable zones around and air bags (additional to the compulsory use of

seat belts). Improvement of the front-end design of passenger cars to reduce injuries to pedestrians and cyclists are of relevance as well.

In the field of active safety a lot of progress could be expected from devices which provide relevant information to the road users, improve their observation or simplify their tasks (emergency manoeuvres). Emphasis is now being placed on the practical application of electronic equipment.
A very interesting development is the so-called Intelligent Speed Adapter (ISA). This device prevents the speed of a vehicle from exceeding a location-specific maximum on the basis of electronic send signals from its surrounding. The technology for the components of this device are available; integration of these components is still needed.
Two real problems have to be solved: to gain public acceptance and support and to develop an introduction strategy.

The three safety principles (functional use, homogeneous use and predictable use) requires the specification of the intended function of each *road and street*. Roads are built with one major function in mind: to enable people and goods to travel, the so-called traffic function. Three options could be distinguished:

- the flow function: enabling high speeds of long distance traffic and, many times, high volumes;
- the distributor function: serving districts and regions containing scattered destinations;
- the access function: enabling direct access to properties alongside a road or street.

Besides a traffic function, streets and roads in built-up areas should allow people to stay in the vicinity of their house safely and comfortably. We call this function residential function and this function could well be combined with the access function.

The concept of sustainably safe road transport comes down to the removal of all function combinations by making the road monofunctional, i.e. by creating categories of roads: pure through roads, pure distributor roads and pure access roads. Multi-functionality leads to contradictory design requirements and also to higher risks.

2.2. Start-up programme on sustainable safety

To pay lip service to the concept of sustainable safety is one point, to put this concept into practice is another. The concept cannot be handed over to just those who are interested in the concept and rely on their individual willingness to come to implementation and leaving those who are not interested aside. The concept requires an active participation of all road authorities in the country and of the whole road safety community as well. The culture in Dutch public administration requires dialogue and consultation to meet this aim. A special Steering Committee, with representatives from the central, provincial and local government and from the water board, has been set up to guide this process. After broad consultation this Steering Committee came to the conclusion that the vision of sustainable safety received broad support. However, different opinions were heard about how to implement the concept and how to finance it.
The Steering Committee made an integrated Start-up programme, covering

the first phase of implementation of sustainable safety (Stuurgroep Duurzaam Veilig, 1997).
This Start-up programme comprises a package of measures which forms essential conditions to fulfil firstly before investments in a sustainably safe road transport system could be made. Secondly, all measures in this start-up programme are relatively cost-effective and could be implemented in a rather short time (three year period) and got support from a wide majority of those who were consulted. It is to be expected that an agreement will be reached in a rather short term.

July the first 1997 a letter of intent had been signed by the central government, provincial and local governments, and by the water-board. This letter of intent comprises the real implementation of the Start-up programme. If all the contracting parties will give their consent, which w expect to be the case by the end of this year, the programme will be realised in the period between 1998 and 2000. The total costs of implementation are estimated to be some 200 million dollars. The central government will provide half of the financial means required, and the other partners will contribute the other 100 million dollars.

The following measures are part of this Start-up programme:
- road classification programme *(for the complete Dutch road network of more than 100,000 km. road length)*, which enables the roads to fulfil their functions satisfactorily and forms a basis to solve the problems of contradictory design requirements;
- stimulate a low-cost introduction of 30 km/h-zones inside built-up areas (excl. roads with a flow function and with a distributor function); an extension is agreed upon of the number of 30 km/h-zones from 10% of the possible zones (as is the case now) up to 50% by the year 2000;
- introducing with simple means a concept of 60 km/h-zones for minor rural roads; some 3,000 km of road length is aimed for to be realised by the year 2,000;
- if needed and possible infrastructural measures like cycle facilities, roundabouts, small-scale measures to support 30 km/h-zones and 60 km/h-zones;
- inside urban areas mopeds on the carriageway instead of on cycle tracks or cycle paths in 1999;
- indication of priority at every junction (outside the 30 km/h-zones); the same priority rules for cyclists and mopeds as for motorised traffic will be introduced;
- public information campaign to support the introduction of sustainable safety; a better police enforcement and education programmes;
- the introduction of a road safety audit in 1998.

Based on the implementation of this Start-up programme further steps will be defined for the implementation of a sustainable safe road network in The Netherlands in the years to come. This Start-up programme is, after all, only the beginning. Implementation of the Start-up programme could be considered as a major step to reach the road safety targets set for the year 2000.

2.3. Demonstration projects

Large-scale demonstration projects are implemented to gather practical experiences when applying the sustainable safety principles. Four of them

are co-financed by the Dutch Ministry of Transport (West-Zeeuwsch-Vlaanderen, Oosterbeek, Grubbenvorst and a project in the northwestern part of the Province of Overijssel). Other plans are developed without such financial support: Westland, West-Friesland, and others. Two of these projects are introduced here. Gaining practical experience and transferring the knowledge are key elements for these demonstration projects.

West-Zeeuwsch-Vlaanderen
One of the demonstration projects is carried out in the very south-west of The Netherlands, close to the Belgian border: the western part of Zeeuwsch-Vlaanderen. This area is a rather rural one with many visiting tourists during the summer season. The road network is without a clear hierarchy of mainly low volume roads. Enormous differences could be observed in usage of this network: a mix of different types of vehicles (fast moving passenger cars together with agricultural vehicles and biking school children using the same physical space).
The high number of severe accidents in the last few years created a strong support in this region for remedial actions and the concept of sustainable safety was adopted as the leading philosophy behind these remedial actions. This choice was made based on cost-effectiveness comparisons of different approaches. Estimations were made on three alternatives: by applying traditional countermeasures, by using sustainably safe principles in a very consistent and systematic manner and the third alternative was a sober variant of the second alternative (DHV, 1994).

In *Figure 3* the results of these three packages are presented. The region has chosen for the 'sober sustainable safety alternative'. It is estimated that this alternative will result in a 60% reduction of the number of road accident casualties and the costs will amount 200 million Dutch guilders.

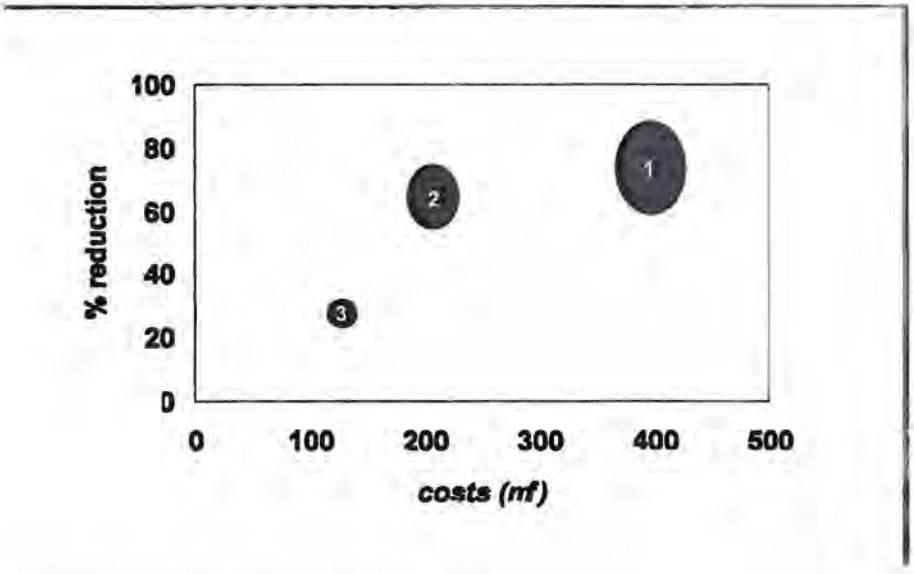

Figure 3 - *Results of the three 'packages'.*

West-Friesland
West-Friesland is a region of 350 square kilometres, 180,000 inhabitants, in the Northwestern part of the country, with relatively high accident figures. A road safety plan has been developed here, based on the principles of sustainable safety. Implementation of this plan could reduce the number

of casualties with 60%, if all road authorities in the region cooperate, if the implementation will be prepared carefully and if the measures are taken quickly.
Two ideas are leading in this plan: to categorise functionally the road system and to design the different types of roads (flow, distributor, access) in order to meet the corresponding functional requirements as indicated before. This leads to roads with a flow function with access control, with separated carriageways and at-grade crossings. Design of distributor roads will depend on the traffic volumes: 6000 vehicles/day has been chosen a criterion. Large areas (1000 - 5000 ha.) will be considered as 60 km/h-zones, where through traffic will be prevented and the 60 km/h speed limit will be enforced. These so-called '60-zones' form the backbone of this plan.

The costs of the implementation are estimated to be 240 million Dutch guilders and the time needed for implementation will be some 10-15 years. A reduction in the number of casualties of 300 (60%) is expected.

3. Costs and benefits of sustainable safety

3.1. The total costs of traffic accidents

The total costs of traffic accidents for the society as a whole can be determined in different ways. Recently, a macro-economic approach has been used, which is described by Muizelaar, Matthijsen & Wesemann (1995). This has been done so that material costs attributable to traffic accidents could be determined from publicly available sources.
The macro-economical approach ensures that not only the costs related to registered accidents is covered, but the actual total costs as well. This also means that care must be taken when relating the total costs to the number of accidents or casualties!
Total costs can be divided into *material and immaterial* costs. Firstly the material costs will be described. The *material costs* were divided into the following categories.

Medical costs
All medical costs caused by the accidents, also those in later years (discounted towards the year of the accident).

Gross potential loss of production
The contribution a person could have made in production if he or she wouldn't have been killed, or temporarily or permanently disabled. In reality this potential contribution will be somewhat lower, since not everybody participates continuously in the production process. However, if one should want to correct for this, one should also introduce a reliable estimate for the rate of labour participation. And one should take into account friction costs, related to the replacement. It is termed the gross loss since production is not being corrected for the future consumption of a killed person. This consumption can be seen as one of the elements of the immaterial part of future life. If one would correct for this element, the full immaterial costs should be taken into account. In the initial estimates this was not done.

Property damage
Damage to cars etc., and all other costs to be paid by the party responsible for the accident (usually covered by the insurance).

Administrative costs
Costs made by police, ambulance, fire-brigade, etc.

Congestion
The part of the total costs of congestion (loss of valuable time, etc.) attributable to traffic accidents.

One also has to consider the *immaterial costs*. The immaterial costs cover the suffering, the loss of enjoyment of life in the case of disabilities, the loss of a fellow person, and so on (this is also called the quality of life).
Initially these costs were not included in the estimates in The Netherlands. (This was due to the fact this estimate should be comparable to the estimates in a previous study.) For the purpose of this study, where the societal effects were being considered, this was felt to be inadequate.

There was, however, no estimate for the immaterial costs in The Netherlands available. A comparison of studies in several other countries showed a more or less fixed relation between the material costs and the immaterial costs (ETSC, 1997). This made it possible to include an estimate for the immaterial damage as well.
This made it necessary however to introduce a correction for the difference between the gross and the net potential production loss.

Category of costs	Total costs
Medical costs	440
Brute potential loss of production	4.346
Property damage	4.188
Administrative costs	303
Congestion costs	250
Total material costs	9.527
Immaterial costs (taking into account the gross/net correction for the potential loss of production)	2.826
Total	12.353

Table 1. *Different categories of costs and cost estimates for The Netherlands (1993), in Dutch guilders (1 ECU = Dfl 2,20).*

In *Table 1* the different categories and the final estimates are given. The total material costs alone amounts to 2% of the total Dutch gross domestic product. This percentage is almost the same as shown in a comparable study executed ten years ago.

3.2. The costs and the effects of a sustainably safe systems

An estimate has been made of the total costs related to the realisation of a sustainably safe road traffic system. For the main categories of roads and areas it has been envisioned what changes in physical implementation would finally be reached.
This description to an estimate of the related investment costs, including the costs related to for instance more education and information, more enforcement.
From the changes in physical implementation it could also be determined what categories of accidents would be affected and in what sense. In combination with the non-infrastructural measures this made it possible to make an estimate of the overall reduction in accident numbers as well.

After all two scenarios have been developed. A 60 billion guilders scenario would lead to an approximately 80 percent reduction in accident numbers. When the total costs would reduce to 30 billion guilders, the reduction would be approximately 60%. For both scenarios a transition period of 30 years has been considered reasonable and reachable.

Overall numbers have been refined, by discerning the casualties into different categories of seriousness: killed, hospitalised, and other casualties (based on registered numbers).
Regarding the effects on the number of accidents, a reduction of 80%, respectively 60%, for all categories has been taken as an upper level for the effect of 'sustainably safe' ('undifferentiated').

One could argue that, taken the nature of the measures envisioned in the notion of a sustainably safe system, these reductions would primarily act on the fatal accidents. This is because they focus on reduction of speed and reduction of differences in speed and mass. We applied the rule of thumb for the relation between speed and the seriousness of an accident: for fatalities speed to the fourth power, for hospitalised speed to the third power, for other casualties speed squared, and speed in itself for accidents with only material damage. Taking 80, resp. 60% for fatalities, we arrived at lower reduction levels for the other categories and took these as a lower level for the overall effect ('differentiated').

The costs of traffic accidents have also been divided into costs attributable to the different categories of seriousness. For this purpose the framework developed by Elvik (1996) has been used.

A final refinement related to the division into fixed and variable costs. The gains of introducing a sustainably safe system should come from the reduction of the costs of traffic accidents. Still, a reduction of the number of casualties in any year will not result in an immediate proportional reduction of costs in the following year. Many organisations will still act on the 'level' of the previous year: we have to reckon with fixed costs on the short term. The available material did not give much information to make this distinction, so the division rests on estimates. The medical costs have been estimated to have a fixed part of 70% during the first 10 years, the material damage is estimated to be fixed for 30% during these 10 years. The other costs are considered fully variable, and after the first 10 years all costs are considered variable.

		Casualties reduction	Reduction in costs first 10 years	Reduction in costs after 10 years
1	60 billion undifferentiated	80%	5300	6900
2	30 billion undifferentiated	60%	4000	5000
3	60 billion differentiated	50% - 80%	4000	5000
4	30 billion differentiated	30% - 60%	2700	3300
5	1st phase (5 years)	30% - 60%	460	570
6	2nd phase (25 years)	30% - 60%	2200	2700

Table 2. *Reduction of accident costs (excl. immaterial costs) in millions of Dutch guilders per year. Source: KPMG, 1996.*

3.3. Financing a sustainably safe road transport system and the benefits for society

The benefits for society can be determined by executing a cost-benefit analysis on the numbers described in the previous paragraphs. This results in a measure for the societal cost-effectiveness of the proposed scheme. Within this analysis we have different options:

- with or without the immaterial costs;
- an upper level estimate (reduction levels equal for all categories of casualties) or a lower level estimate (reduction levels differentiated);
- a 60 billion guilder scheme with 80% reduction or a 30 billion/60% reduction scheme.

As said before, the transition period was set on 30 years. This is also the lifespan of most investments in infrastructure. Therefore, the period covered by the cost-benefit analysis was set on thirty years as well. The costs and benefits for each year have been discounted towards the first year with a nominal interest rate of 4% (this is the rate the Ministry of Transport and Public Works uses when evaluating major projects in infrastructure).
We set the total expenditure for each investment to the first year, and supposed that all gains would be effective from the next year onwards. This of course is not a true representation of reality, but it does hardly make any difference for the cost-effectiveness that is being computed.

Investment costs	Annual benefits first 10 years	Annual benefits 10-30 years	Net present value at 4% interest	Rate of return (net present value = 0)
60 billion	4000	5000	18000	6%
30 billion	2700	3300	22000	9%
5 billion	460	570	4000	9%
25 billion	2200	2700	18000	9%

Table 3. *The social returns of sustainable safety in a conservative scenario (in millions of Dutch guilders). Source: KPMG, 1996.*

When we consider only the material costs, and take the lower level for the reduction levels, the cost-effectiveness is 6% for the 60-billion scheme, and 9% for the 30-billion scheme (*Table 3*). This lower level for the cost-effectiveness thus lies clearly above the comparison rate of 4% the Ministry applies. This means that also if one chooses a higher nominal interest rate, the net cash value will still be positive.
In other societal cost-benefit analyses considering the immaterial costs is also customary. When this is done, still using the lower reduction levels, the cost-effectiveness would rise to 12, respectively 16%.
Would one apply the upper reduction level, then a cost-effectiveness of 14% and 22% would be reached.
Finally it should be stressed that these levels of cost-effectiveness have been computed by only considering the effects on traffic safety. The kind of investments in infrastructure we are dealing with will also have positive effects on noise levels, environmental quality, and aspects of mobility.

The Dutch government annually spends about 6.8 billion guilders on the road infrastructure. Just over half of this is invested in (major and minor) maintenance work, while the rest represents investments, excluding the (no longer freely disposable) capital costs of earlier investments (Poppe & Muizelaar, 1996). In view of both the size of this sum and the number of kilometres of road annually renewed or newly constructed, this offers sufficient space to realise a sustainably safe system within a period of thirty years. Existing road infrastructure budgets offer sufficient space to realise a sustainably safe system. Political decisions are needed in order to redirect these budgets.

A second approach might be to connect investments for and benefits of a sustainably safe road transport system.

The benefits of a sustainably safe traffic system can be divided into effect for various groups: government, private individuals (owners of motor vehicles), employers (*Table 4*). The group of private persons and the group

of employers would benefit most, such that a proportionate investment would be profitable in this case. However, this leads to a kind of paradoxical obstruction: if only the odd individual invests, no gains are made; if many invest the benefits are also shared by those who do not contribute.

	Annual benefits first 10 years	Annual benefits from 10 years onward	Net present value of benefits at 4% interest	Net present value of benefits at 8% interest
Government	200	300	3600	2200
Private persons	1300	1700	27200	17200
Employers	1200	1300	21300	13600
Total	2700	3300	52000	33000
Insurers 3% of total			1500	1000

Table 4. *The benefits of sustainable safety in a conservative scenario in millions of Dutch guilders. Source: KPMG, 1996.*

In order to still encourage individuals or companies to invest, therefore, government intervention is likely to be necessary. Insurance companies (both motor vehicle, life and health cost insurers) who would also profit from the steady drop in claims - and hence in payments - could be employed as intermediary for this purpose.
But from this perspective it might become clear that the key stakeholder to realise a sustainably safe road traffic system is the government, either directly as investor or indirectly as 'broker'.

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