SWOV Fact sheet

VVR-GIS 3.0 : support for investment decisions

Summary
VVR-GIS 3.0 is a software tool whose purpose is to help regional authorities in the Netherlands to decide how to spend their money on road safety measures. This tool makes it possible to compute and compare different regional sets of road safety measures. By using it, regional road authorities and policy makers can generate and substantiate their traffic and transport plans. VVR-GIS 3.0 consists of a number of elements: the user interface (the maps, buttons and menus), the actual calculation kernel (a separate software module), and two databases: the VVR Database with information on for instance mobility scenarios, measures and their effects et cetera, and an external database with information about the road network.

Background
Decisions regarding investments in road safety often have to be taken at local or regional level (urban region, province, large municipality), for instance whether to adapt the infrastructure (e.g. construct a bicycle path or a roundabout), but also about introducing or extending the enforcement of regulations (e.g. installing red light cameras). As money can only be spent once, it is to the advantage of regional and local authorities to be able to make clear and well-substantiated choices regarding their investments.

Regional authorities would therefore also have to decide whether and how they spend their money on road safety measures. VVR-GIS 3.0 is an instrument whose purpose is to help these authorities in the Netherlands to arrive at such decisions, as it makes it possible to compute and compare different sets of regional road safety measures. VVR-GIS 3.0 is based on the Regional Road Safety Explorer (VVR), a calculation method used to estimate the costs and effects of road safety measures. SWOV developed the VVR in 2001 at the request of the Dutch Ministry of Transport in order to help the various regions in the Netherlands with their traffic and transport plans. With the VVR, the regions were able to harmonize these plans with their regional road safety targets. The VVR and its application have been comprehensively described by Janssen (2005).

The VVR consists of a large number of spreadsheets in Excel. Instead of continuing to develop these spreadsheets and keeping them up-to-date, SWOV decided to convert the VVR's calculation method into a software module. This module can then be linked to a Geographic Information System (GIS) and inserted in software applications developed by third parties. We have called the instrument generated in this way the VVR-GIS.

In recent years, SWOV has cooperated with consultants and government bureaus on the development of the VVR-GIS in connection with the Transumo project *Area-orientated Integrally Safer*. The consultancy firm VIA is currently providing the link to a GIS and has developed the user interface. The result of this cooperation is VVR-GIS 3.0. A comprehensive description of VVR-GIS 3.0, and in particular the calculation module, can be found in Reurings, Wijnen & Vis (2009). This Fact sheet gives a short summary.

What are the purpose and target group of VVR-GIS 3.0?
The purpose of VVR-GIS 3.0 is to help regional road authorities and policy makers with generating and substantiating traffic and transport plans. For with VVR-GIS 3.0, the effects of road safety measures (expressed as prevented crashes and casualties) of different regional plans can be estimated, and these estimates can subsequently be compared with each other or with the regional road safety targets. As VVR-GIS 3.0 can also perform a cost-benefit analysis, the user can determine which plan is the most cost-effective. VVR-GIS can therefore be regarded as an instrument in the search for the most cost-effective road safety plan.

How is VVR-GIS 3.0 constructed?
VVR-GIS 3.0 consists of a number of elements. The user sees only the ‘user interface’ – the maps, buttons and menus. The calculations are carried out by the so-called calculation kernel – a separate software module. This calculation kernel uses all kinds of data, such as information on mobility growth scenarios; these data are stored in the ‘VVR Database’. Lastly, the user interface obtains information about the Dutch road network from an external database containing road features ('Wegkenmerken+') (see *Figure 1*).

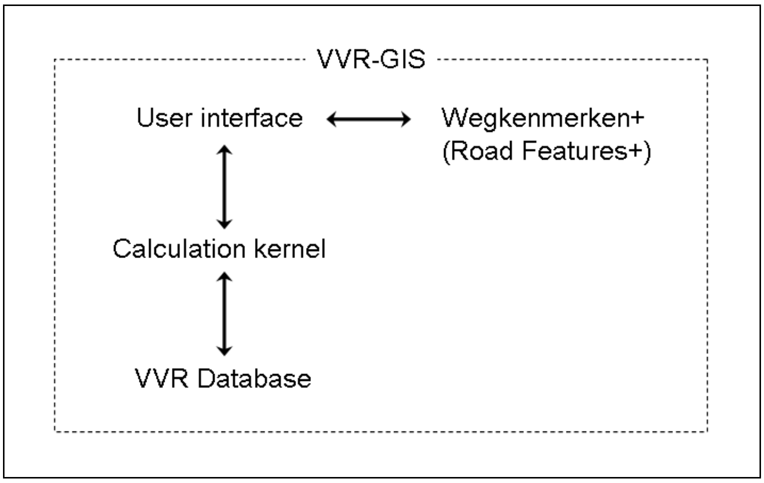

Figure 1.

The following is a short description of the four elements:
- The *calculation module*. This module has been developed and is managed by the SWOV. It consists of a single module which is designed to calculate the road safety effects of the various sets of measures selected by a user, taking into account the growth of mobility according to different scenarios. In addition to road safety and mobility computations, the calculation kernel also performs a cost-benefit analysis.
- The *VVR Database*. A variety of data is needed for the computations. Some of this data, such as the choice of sets of measures and their effects, is permanent and is included in the VVR Database, which is augmented and managed by the SWOV.
- The *user interface*. This provides communication between the end-user of VVR-GIS 3.0 and the calculation module. Via the user interface of VVR-GIS, end-users can simply state where and when they wish to apply a particular set of measures. Once the calculation module has completed its computations, the user can request and view all the results in the user interface. The current interface has been developed by consultancy firm VIA.
- The *external database Wegkenmerken+*. In order to make it easy for a user to select road sections and intersections where he wishes to apply a set of measures, the user interface is linked to a GIS environment. Currently, Wegkenmerken+ is being used, as in principle it contains the road and intersection features required by VVR-GIS 3.0.

Which measures can be calculated?
Theoretically, VVR-GIS 3.0 can calculate all the measures related to regions and locations. In practice however, only those measures are considered whose effect estimates are known. The following is a list of measures that are currently available in VVR-GIS 3.0:
- Sustainably safe layout of Zone 30;
- Sustainably safe layout of Zone 60;
- Sustainably safe layout of a through-road;
- Construction of a separate bicycle track;
- Construction of a separate (moped) bicycle track;
- Construction of a difficult non-physical separation of driving directions and a (moped) bicycle track;
- Construction of a physical separation of driving directions and a (moped) bicycle track;
- Construction of a service road;
- Extension of an obstacle-free zone;
- Construction of semi-hard shoulders;
- Construction of a WICON crash barrier;

- Ban on parking on or beside the carriageway;
- Placing a speed camera;
- Converting an intersection into a roundabout;
- Raising an intersection;
- Laying out an intersection as an exit construction;
- Equipping an intersection with VRI;
- Placing a red light camera;
- Intensifying alcohol enforcement;
- Intensifying seat belt enforcement;
- Enforcing the use of crash helmets by moped riders.

Wijnen (to be published) provides a comprehensive description of all these measures, as well as estimates of costs and effects.

How does the calculation module of VVR-GIS 3.0 work?
The calculation kernel performs its calculations in a number of steps. These are called calculation steps. The calculation steps are:
1. calculating the reference situation;
2. calculating the baseline prognoses;
3. calculating the measure prognoses;
4. calculating the effects of sets of measures;
5. the cost-benefit analysis.

The following is a brief description of each calculation step.

1. Calculating the reference situation
The reference situation is the basis for the calculation. It describes the region's traffic and road safety situation for a particular year. This year is called the reference year, and can be selected by the user of VVR-GIS 3.0. The user also selects the region. VVR-GIS 3.0 recognizes twenty regions in the Netherlands: seven urban regions, twelve (remaining) provinces, and the Netherlands as a whole. The traffic situation in the reference year is described by the vehicle kilometres (distance covered) per road and intersection category in the region. The road and intersection categories are derived from the categorisation according to Sustainable Safety. The road safety situation in the reference year is described as follows:
- the real number of injury crashes, fatalities and in-patients per road and intersection category in the region;
- the crash rate (number of injury crashes divided by the vehicle kilometres) per road and intersection category;
- two 'degrees of severity' that describe the results of crashes: the number of casualties (fatalities and in-patients) per crash and the share of fatalities amongst the casualties.

The numbers that describe the traffic and road safety situation are called reference numbers. They are needed to perform other calculations, such as determining the baseline prognoses.

2. Calculating the baseline prognoses
A baseline prognosis for one year after the reference year contains the expected number of injury crashes, fatalities and in-patients for that year, not taking into account the effects of local or regional measures. The baseline prognoses are based on two developments on which the user of VVR-GIS 3.0 has no (direct) influence: the change in mobility and the 'autonomous' change of the crash rate.

The autonomous change of the crash rateis the result of:
- national road safety measures; these may be new measures, or measures that were already taken in the past;
- local or regional measures that were taken in the past;
- learning effects: for instance, road users learn how to participate in traffic more safely, and car manufacturers learn how to make vehicles safer.

Once the vehicle kilometres and the risk of a road or intersection category have been calculated for a particular year, it is easy to estimate the number of injury crashes for that year – it is simply the product of these two developments. On the assumption that the seriousness of the crashes (casualties per injury crash and fatalities per 100 casualties) never varies regarding the reference year, the baseline prognosis for the number of fatalities and in-patients can also be determined.

3. Calculating the measure prognoses
Once the baseline prognoses have been determined for each year, the effects of measures can be calculated. The result is the so-called measure prognosis. A measure prognosis is a prediction of the number of injury crashes, fatalities and in-patients during a year when the effects of selected sets of measures are taken into account.

The effects of the sets of measures applied are calculated with regard to the baseline prognoses. This means that the numbers of injury crashes, fatalities and in-patients are multiplied according to the baseline prognoses with the reduction factors of the selected sets of measures.

4. Calculating the effects of the sets of measures
The effects of sets of measures are expressed as the number of injury crashes, fatalities and in-patients prevented. These are not the reductions compared to the reference year, but compared to the baseline prognosis. In this way, the reductions reflect only the effects of the sets of measures applied, and not those of miscellaneous developments on which the VVR-GIS 3.0 user has no influence.

5. The cost-benefit analysis
A cost-benefits analysis determines the effects for society of an investment, for instance of an investment in road safety. This means that a cost-benefit analysis answers the question of whether the benefits of an investment counter-balance the costs from a social point of view. Apart from looking only at the financial aspects, other aspects such as safety, emissions and congestion can also be taken into account. In this way, a cost-benefit analysis makes it possible to assess the social effectiveness of an investment. For a more detailed explanation, we refer you to the SWOV Fact sheet *Cost-benefit analysis of road safety measures.*

A cost-benefit analysis is used in VVR-GIS 3.0 to compare various choices of sets of measures with each other. The costs in this analysis consist of the costs for constructing and maintaining the sets of measures; the benefits consist of the crashes, fatalities and in-patients (expressed in terms of money) that are prevented as a result of the sets of measures. This comparison can help the user to make a definite choice between possible combinations of sets of measures.

VVR-GIS 3.0's calculation method and the data required to perform them have been carefully developed and compiled. The calculation method however is based on a model of reality, and therefore cannot describe reality precisely. The estimates of the absolute numbers of (prevented) crashes and casualties are therefore uncertain. However, when comparing different road safety plans in a particular region, these uncertainties are less important. VVR-GIS is therefore very suitable for comparing different plans, i.e. for answering the question of which combination of measures is the most cost-effective in a given region.

How can VVR-GIS be obtained?
The calculation module of VVR-GIS 3.0 has been developed by SWOV, and is made available to external parties free of charge (SWOV, 2009), who can then develop their own user interface (or have one developed). As part of the delivery, SWOV tests the final software on the correctness of the link to the calculation kernel. In return for the calculation module, SWOV asks to have access to the calculation sets or baseline data for research purposes. For more information, please contact **info@SWOV.nl**.

Is supplementary research carried out?
VVR-GIS is the type of product that is never done, and continues to undergo development. In their report, Reurings, Wijnen & Vis (2009) have made a number of recommendations for the improvement and further development of VVR-GIS 3.0's calculation module. Among others, VVR-GIS 3.0's calculations could be improved upon if the estimates of autonomous developments were more accurate. The assumption that the seriousness of crashes does not change with regard to the reference year for instance, is not quite correct. For instance, improvements to vehicles (a development on which the VVR-GIS 3.0 user has no influence) could reduce the number of casualties per injury crash and the number of fatalities per 100 casualties more quickly than the number of injury crashes itself.

A further development of VVR-GIS 3.0 could consist of adding an environment and mobility module. The purpose of these modules is that the effects of road safety measures on mobility and the environment could be taken into account. This would be a useful addition to VVR-GIS 3.0, as it would make it possible to arrive at a more integral comparison when deciding on a cost-effective set of measures.

The VVR-GIS list of sets of measures should be updated and expanded. Updates are necessary to be able to use the latest insights and the effects of sets of measures in VVR-GIS. The addition of new sets of measures to the list will allow VVR-GIS to relate better to the wishes of end-users. However, it is not possible to add new sets of measures out of the blue. It is only possible if there is sufficient reliable literature about the effects of a measure.

In the end, practical experiences with its use will undoubtedly lead to further adaptation and improvement of VVR-GIS.

Publications and sources

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