

## Summary

Research project: 'Application of a simplified evaluation tool to decisions in the field of physical safety.'

The decision-making on improving and ensuring physical safety, by taking measures or choosing between options for which safety is an important aspect, is difficult for various reasons. First of all, the effects of these measures or options are uncertain in general and will often depend on the context. Secondly, the value of 'safety' is difficult to quantify, which makes it complex to compare it for example with the costs of the measure considered. Thirdly, measures have side-effects, social and economic, which should be taken into account when different measures are compared on their effects and total added value. Finally, the decision-making is complicated by differences in interests and preferences of the participants involved. The owner, designer, builder, user, the authorities, police and fire brigade may have different priorities, which could lead to different choices. All this complicates the evaluation and the choices between the measures or options considered and the building of consensus between participants.

Given this complexity, this research addresses the question, to what extent quantitative methods and tools are used in practice to support the decision-making on physical safety. Furthermore, whether the 'Afwegingsinstrument Veiligheid en Economie', a decision support tool developed in 2008/2009, could improve the quality of the decision-making. This tool was developed in a research project to improve the quality of decision-making on measures against criminality and nuisance.

Just like this former project, the research at hand was commissioned by the Dutch Ministry of Safety and Justice, Research and Documentation Centre, and has been carried out by *Decide*, a research- and consultancy firm linked to the RUG, University of Groningen; *Decide* is part of the dutch group.

In the first stage of the project the researchers made a quick scan of the extent to which quantitative methods are used in practice in the decision-making on choices between safety-measures. The quick scan consisted of a desk study and interviews with four experts in the field. Given the scope of the scan, the conclusions have to be tentative.

In practice, quantitative decision-making support methods are barely used. We sometimes see cost-benefit analysis (CBA), cost-effectiveness analysis (CEA), multi-criteria analysis (MCA) and scenario analysis. But most of the time, choices between alternative safety-measures or options, is left to external bureaus, which, on the basis of their expertise, come to unambiguous advises.

For some situations or processes in which safety is an important item, handbooks or protocols are available, like the 'Veiligheidseffectrapportage' (VER) en the model 'Integrale Brandveiligheid Bouwwerken' (IBB), both developed by the 'Centrum voor Criminaliteitspreventie en Veiligheid' (CCV). But these also don't seem to be applied often.

Experts mention a number of reasons that hinder the use of quantitative decision-making support methods in practice. The most important are:

- There is often a focus on neutralization of an unsafe situation or the danger of a calamity; then a thorough systemic evaluation takes too much time.

- The planning of large (building) projects, in which safety is an important aspect, often are subjected to and determined by interactions between authorities and contractors, in which (political and commercial) preferences play a role. In that situation there is little demand for an objective evaluation of all alternatives.
- Safety risks are difficult to value financially; this makes an integral evaluation, in which all aspects and effects are taken into account, problematic.
- Applying quantitative methods are often costly and time-consuming.
- A lot of decision-makers are unaware of available decision support methods and their surplus value.

Given this context, the researchers recommend an investigation of how decisions and evaluations are made on choices between safety-measures and on (building-) options in which safety is a important aspect. How are these complex choices made without systemic methods and/or decision support tools?

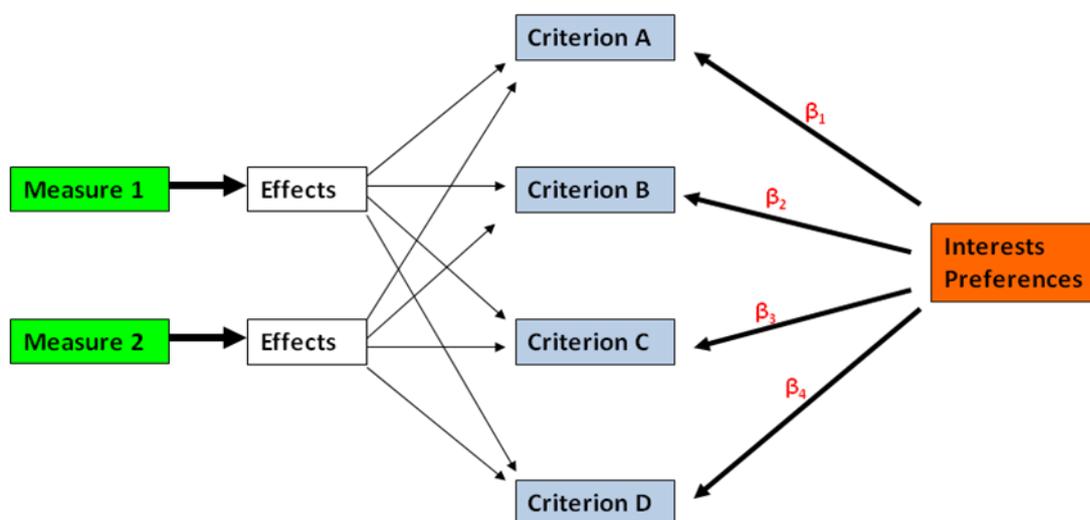
The researchers applied the earlier mentioned 'Afwegingsinstrument Veiligheid en Economie', which from now on we call 'the evaluation tool', in three cases on its practical usefulness. This decision support tool is a special (simplified) application of multi-criteria analysis (MCA). With this tool several alternative measures can be compared. Subsequently the tool determines which measure is preferred mostly by the user(s) of the tool.

Applying the tool, the user has to:

1. Determine the alternatives, in this case the safety-measures or options to be considered.
2. Determine the criteria by which the alternatives should be evaluated.
3. Estimate the effect of each alternative on each of the evaluation criteria.
4. Decide on how important the evaluation criteria are, relative to each other. This is done by assigning weighting coefficients to the criteria.

The tool then determines the alternative that has the highest total score on all the (weighted) effects on all of the criteria.

The figure below shows the relation between the elements and parameters in the evaluation tool. The measures on the left have effects on several evaluation criteria. By weighting the criteria according to how effects on these criteria are valued ( $\beta$ 's) and by summing over these effects, the tool arranges the measures in order of the value to the user. The  $\beta$ 's are determined by the interests and preferences of the user(s) of the tool.



The method of multi-criteria analyse has the advantage that effects of a different kind can be aggregated in the analysis. Furthermore the method can handle effects that are difficult to quantify.

The general aims of applying the evaluation tool are:

- Facilitation of the evaluation process of measures.
- Improving the quality of the decision-making process.
- Making the evaluation more transparent.
- Supporting the collective decision-making.

As mentioned, the evaluation tool was applied in three cases. Apart from testing the practical applicability, the surplus value for the users was established.

In the first case the question was: what is the best place in the train station area of the city of Arnhem to build a hotel, from a viewpoint of safety(risks). The client or commissioner of the evaluation was the 'Safety- and Health Region Middle Gelderland.'<sup>1</sup> The second and third case concerned the question which measures should be taken for objects, for which the fire brigade exceed the maximal response time permitted by law. These measures should raise the safety-level (preventive and/or in case of a fire). In the second case measures were evaluated for a specific object (a care-institution for elder people). In the third case, the evaluation concerned a whole village for which the fire brigade exceeded the maximal response time permitted. The last two evaluations were commissioned by the 'Fire Brigade Middle- and West Brabant'.<sup>2</sup>

The evaluation tool appeared to be perfectly applicable in the cases. This concerned not only the modelling of the tool but also the application in a practical sense. The users were more than satisfied and planned to use the tool more often.

One of the conclusions with respect to the application of the evaluation tool is that clarity about the goal for which is used, is important. In cost-benefit analysis (CBA) one tries to make an inventory all financial consequences of the different alternatives under consideration. In this process estimates have to be determined as empirical and objective as possible. The result is the alternative which is financially optimal. The evaluation tool on the contrary is less pretentious and aims to support the *quality* of a collective decision-making *process*, accepting that the choice and weighting of evaluation criteria always is subjective to a certain extent and that uncertainty plays an important role in estimating the effects of measures. Application of the tool results in getting as much consensus as possible about the expected effects and arriving at a set of measures which are mostly valued by the participants in the evaluation process, give their priorities.

In the evaluation of safety-measures the evaluation tool lacks a number of problems inherent to the application of quantitative methods like cost-benefit analysis that use 'hard' numeric data.

1. The application of the evaluation tool is - compared to methods like CBA - cheap.
2. An analysis with the evaluation tool can, if necessary, be carried out in one day.
3. The evaluation tool enables the user to take into account criteria that are difficult to quantify, like 'safety-risk', which is almost impossible in methods like CBA.
4. The tool can cope with the uncertainty of effects, which is often the case in safety-measures.

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<sup>1</sup> Veiligheid- en Gezondheidsregio Gelderland Midden (VGGM)

<sup>2</sup> Brandweer Midden- en West Brabant (BWMB)

The 'Afwegingsinstrument' was designed in such a way that decision-makers in companies and local authorities would be able to apply the tool themselves, instead of hiring an external bureau. The researchers think that most decision-makers are capable of this, provided that they are supervised the first time by someone who is experienced in applying the tool.

Most users of the tool find the selection and formulation of the evaluation criteria difficult. The application of the evaluation tool would be facilitated if the list of evaluation criteria is standardized for a specific domain of decision-making, for example the choice of measures in buildings to reduce fire risks. In the opinion of the researchers standardisation is quite possible for different decision-making domains, which also will improve the quality of the evaluation.