

Phased plan for cost-benefit analyses

Version 1.4

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Introduction

The phased plan for cost-benefit analyses has been drafted in the context of the Enabling Technology Project Behaviour and Innovation. The goal is to describe a single, shared approach to cost-benefit analyses at TNO. The plan was described in outline in a PowerPoint presentation. This document provides a more detailed description.

It is intended as a reference for TNO staff who deal with cost-benefit analyses (SCBAs) in the course of their work. First of all, it is intended to help staff proceed through the right steps and to make the necessary decisions. Secondly, it will help to show clients (and other stakeholders) in a structured and standardised way how TNO conducts cost-benefit analyses. Thirdly, it can also help in the formulation of the right questions and in adopting a sound critical approach when a cost-benefit analysis is conducted by a party other than TNO.

In view of the stated goals, the presentation and this document focus primarily on people who have relatively little experience with cost-benefit analyses so that they can acquire a clear picture of the steps to be completed and what is involved. Researchers with more experience can benefit from using a fixed procedure and by teaching others accordingly. More experienced researchers will probably have additional requirements when their work involves specific options and decisions in specific areas (for example when the modelling or monetisation of effects are involved). More specialist issues of this kind are not covered by this phased plan. We do hope to engage in a follow-up project that will address these issues in greater detail in a CBA guideline for TNO.

The box below shows the steps involved in a cost-benefit analysis. These steps will be explained further in the remainder of this paper.

Steps in a cost-benefit analysis:

1. Specifying the goal of the cost-benefit analysis.
2. Specifying innovations: which innovations are being investigated and what is the baseline alternative used to assess them?
3. Stakeholder analysis: who are the actors involved in the implementation of policy for whom the costs and benefits are being described?
4. Survey and specification of all relevant costs and benefits/effects.
5. Operationalisation of costs and benefits: preferably monetisation or, at the least, quantification.
6. Specification of time horizon for the cost-benefit analysis.
7. Collection of data about costs and benefits: as much as possible on the basis of empirical data, with assumptions where necessary.
8. Performing cost-benefit analysis: calculations and sensitivity analyses and/or simulations where necessary.
9. Presentation of the results and recommendations.

Step 1: Goal of cost-benefit analysis

Cost-benefit analyses may be conducted for various reasons. It is sensible to take time to think in advance about what one wishes to achieve. The various types of goals include:

- Drawing attention to a problem and determining the potential benefits of solutions
- Looking for stakeholders who would be interested in making investments
- Justifying an investment decision
- Mapping out the effects/results of an investment
- ...

Step 2. Comparing innovations with baseline alternative

A cost-benefit analysis involves an appraisal of one or several innovations as compared to a baseline alternative¹. An innovation may be a new intervention or measure, or a specific policy decision. The baseline alternative is the scenario involving no innovation. The baseline alternative can actually mean that nothing will be done, or it may involve an alternative deployment of financial resources. The first step in a cost-benefit analysis involves identifying the innovations we want to investigate. In addition, a definition is required of the baseline alternative that will be used to determine the costs and benefits of the innovations.

Step 3. Stakeholder analysis: integral or partial cost-benefit analysis

To arrive at a proper comparison of innovations using a cost-benefit analysis, the costs and benefits of various innovations must be estimated as well as possible. The first step involves identifying the stakeholders who play a role in the issue and the innovations. The emphasis here is on identifying the stakeholders who are needed to get innovations off the ground and the stakeholders who will feel the impacts of the project alternatives.

Stakeholders may include: the government, employees, clients, employers, insurers, etc.

This is not just a question of identification; the relationships between the different stakeholders are also relevant and need to be described. Which stakeholders are needed to get the innovations off the ground? Where appropriate, we can visualise stakeholders and the relationships between them: for example by using the [impact arena](#) or with Value Network Analysis (VNA)².

Once the stakeholders and their mutual relationships have been described, the next step is to determine the perspective for the implementation of the cost-benefit analysis. An *integral* cost-benefit analysis looks at all the actors involved (directly or indirectly) and, in this way, clarifies the 're-distribution' effects for the stakeholders. For example: the money a company spends on courses for its staff represents income for the company that organises the courses. A cost-benefit analysis can also be conducted from the point of view of one specific actor, the company spending the money for example. In that case, the term *partial* cost-benefit analysis is often used.

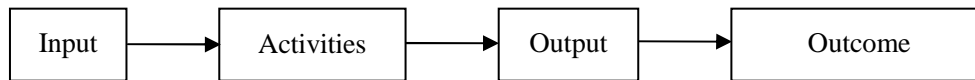
If it is decided to conduct a partial cost-benefit analysis, it is important to think about the scale of the analysis or the scale of the impact of the innovations: company or institution / municipality / regional / national?

Step 4. Review and classification of costs and benefits

When reviewing costs and benefits, it is advisable to adopt a structured approach so that all the relevant costs and benefits are actually identified. A logical model that links input and activities to output and outcome is usually very helpful. A logical model of this kind shows in a schematic way what is needed in terms of financial and other resources (input) and what activities have to be carried out to generate concrete returns (output) and ultimately to achieve the desired goals (outcome).

¹When discussing cost-benefit analyses, the term 'project alternative' is often used.

² See the annex for examples of an [impact arena](#) and a [Value Network](#).



The difference between outputs and outcomes is that output comprises the immediately apparent returns of the activity (for example the number of traineeships and jobs), whereas the outcome refers to the ultimate direct and indirect effects (for example the number of people who move on to another job or the improvement in someone's self-confidence).

When reviewing costs, it is useful to think first about the cost drivers in place. Examples are:

- The number of people (students/patients/clients/etc.) affected by the innovation;
- The number of sessions or treatments;
- The number of locations where the innovation is implemented.

For each cost driver, it is then possible to define the various cost items using the following classification:

- One-off costs: costs for the development of policy, start-up costs and any incidental costs during implementation.
- Overheads: annually recurring costs that are more or less fixed as soon as it has been decided to introduce an innovation, such as costs for housing, project management and administrative support.
- Variable costs: costs that depend on specific variations in the approach to implementing the selected innovation, such as the number of participants in a project.

In terms of the benefits or effects of innovations, we can make a broad distinction between the following types of effect:

- Direct effects: effects on the people involved that are the direct result of the innovation (for example moving on to regular employment or a better structure in clients' lives).
- Indirect effects: effects resulting indirectly from the innovation through transaction mechanisms (for example: higher tax revenue for local authorities because local taxes are no longer waived when people move on to regular employment).
- Side-effects: effects on people who are not directly involved (such as the effect on other people living in a town or on members of a participant's family). Please note: these may be both positive effects and undesirable negative effects.
- Re-distribution effects: effects that are benefits for one party may be costs for another party (local authority spending on job creation also represents revenue for the agencies they appoint).

When determining costs and benefits, consideration should also be given to the effects outside the area concerned (impact on the police and the justice system, for example). And a conscious attempt should be made to think about possible undesirable/counter-productive effects as a result of the innovation.

A cost-benefit analysis should, in principle, describe all the relevant costs and benefits. In practice, it is advisable to set priorities for the effects to be examined in detail (particularly if there are time and budget constraints affecting the study). The prioritisation of effects depends on:

- a) The anticipated scope of the effects and therefore the extent to which they determine the outcome of the cost-benefit analysis.
- b) The importance of the impact on the stakeholders.

This appraisal can be made in advance on the basis of the stakeholders' wishes and ideas, the ideas of experts and/or results from previous research.

Step 5. Operationalisation of costs and benefits

Once they have been determined, the various costs and benefits can be operationalised so that they can be used in the ultimate cost-benefit analysis. Costs and effects resulting in concrete cash flows are stated in euros (or another currency). At this point, we also date the cash flows by year so that we can determine the net present value (see step 6).

A decision has to be made about how to present effects that do not result in any concrete cash flows. We can decide to monetise these effects (state them in money terms) as much as possible. We can use, for example, shadow prices to do this³ or methods like *willingness to pay*⁴. This allows us to allocate a value in euros to commodities that are not traded on a market and for which no direct price is available.

For effects that cannot be monetised or that we decide not to monetise, a quantitative approach to operationalisation is also preferable. We can, for example, use validated scales or monitoring data here.

If quantifications of this kind are not possible either, we can still try to state the direction (and possible scale) of effects in quantitative terms (for example as very, or mildly, positive effects). If even this proves impossible, the final option is to state effects in the cost-benefit analysis as items for later consideration. No description is given but there is an indication that the effects can be expected in the future.

It is important, during the operationalisation of effects, to take into account what stakeholders think is important, as well as the goal of the cost-benefit analysis (step 1). In some cases, it is important to group everything under a single numerator or number (as in the SROI method⁵), and it is useful in this respect to monetise the various factors as much as possible. In other cases, it may actually be very useful to understand different effects at the scale that is relevant to the particular effect.

Step 6. Determination of the time horizon for the analysis

The next step, on the basis of the costs and benefits that have been identified and operationalised, is to collect the data required for the actual implementation of the cost-benefit analysis. Project implementation can take many years. That means that the costs and benefits will be spread out over a long period of time. It is therefore necessary to adopt in advance a time horizon that will be used for the cost-benefit analysis.

The usual approach when a longer period of time is involved is to allocate less weight to costs and benefits located in the more distant future than to comparable figures in the present. There are two reasons for this:

1. A euro now is worth more than in, for example, five years from now.
2. Costs and benefits located more in the future are less certain.

The future costs and benefits are therefore corrected using a *discount rate*, with the balances for the various years being totalled. The resulting figure is the *net present value* of the project for the period covered by the analysis.

In principle, the discount rate used is determined by the baseline alternative: leaving the money in the bank or investing in other projects. Governments usually adopt the risk-free interest rate as the discount rate. This is usually 3-5%. Commercial companies usually use higher discount rates based on the weighted average cost of capital (WACC)⁶. In practice, different discount rates are also used for the costs and benefits in the analyses. The discount rate used for the benefits is usually higher than the rate used for the costs because of the additional uncertainty relating to the benefits.

The net present value is easy to calculate (in Excel, for example). Useful calculators are also available on the Internet. For example: <http://www.calkoo.com/?lang=12&page=21>.

³ Shadow prices are fictive prices for goods or production factors that are not traded on markets.

⁴ What are people prepared to pay for a particular return (such as better health or a faster journey).

⁵ SROI stands for Social Return on Investment. See Scholten, 2005.

⁶ The costs incurred by a company for the capital used to finance it. The WACC is calculated by allocating weightings to borrowed capital and equity capital on the basis of the share of the two types of capital in the overall financing of the company.

Step 7. Data collection

Within the period being analysed, estimates (in advance) or calculations (after the event) are made of the costs and benefits on the basis of past experience, preferably supported by empirical data. If data is unavailable or inadequate, assumptions may be made about particular costs or effects. The balance of the financial effects is then determined for each year.

A broad order of preference for data sources is as follows:

- Recorded data (about costs and benefits by the stakeholders).
- Results of model analyses (for example, analysis of net effectiveness⁷).
- Key figures based on the literature (for example, study of costs using the Health Care Insurance Council manual or www.kostenvanziekten.nl; take into account the year in which the costs have been identified and the year in which the costs are calculated in your study; adjustments may be made for inflation using consumer price indices such as those on, for example, www.Statline.nl).
- Meta-analysis of existing studies.
- Surveys of stakeholders (for example, using willingness to pay or vignettes⁸).
- Expert consultation (individual, group-based or Delphi⁹).
- Assumptions by the researchers.

Step 8. Performing cost-benefit analyses, sensitivity analyses and simulations

The financial balances and the non-monetised effects of the different alternatives are then compared with the costs and benefits associated with the baseline alternative. That leads to the final description of the net effects of the implementation of a specific project. The results of the cost-benefit analysis are dependent on any assumptions made about the units of measurement used. To determine the extent to which these assumptions affect the outcomes of the analyses, sensitivity analyses may be carried out by making different assumptions. Sensitivity analyses can be conducted in both univariate and multivariate forms. In other words, one or several parameters can be varied at the same time.

We can also conduct simulations looking at different scenarios. With probabilistic modelling, we can use Monte Carlo simulation, which involves analysing the variation in the outcome as a result of variation in the data and/or variation in the parameters or estimated parameters¹⁰.

An important area requiring attention in the modelling and actual implementation of analyses is the determination of causality and attribution. Causality relates to causal relationships. What causes the actual occurrence of the effects? Attribution relates specifically to the allocation of effects to the innovation. This is necessary in order to determine the "net effectiveness" of interventions.

Step 9. Presentation and interpretation of results, → recommendations

The results of a cost-benefit analysis can be presented as a single outcome measure (such as a financial balance or the cost per QALY¹¹). In an [acceptability curve](#), various alternatives can be compared to the willingness to pay. It is also possible to present several outcome measures alongside one another in the form of a balanced scorecard or dashboard¹². With cost-benefit analyses, it can also be useful to present the results in the form of a tool that stakeholders can use for their own simulations.

⁷ Net effectiveness is the added value of the innovation in terms of achieving the effects. The net effect is equal to the outcome (the gross effect), after correction for external factors.

⁸ A vignette is effectively a description of a situation on the basis of various characteristics (attributes). The vignette method involves showing the interviewees a number of these vignettes and asking them on each occasion to provide an assessment of the given situation.

⁹ The Delphi method is a method used to ask different experts for their opinions on an individual basis. The aim is to achieve consensus by feeding back the answers from the other experts on an anonymous basis in several rounds.

¹⁰ A Monte Carlo simulation involves a large number of simulations, each time with different conditions (in the data and/or parameters). The result of this set of simulations is a distribution function that reflects the entire scope of possible outcomes.

¹¹ Quality Adjusted Life Year.

¹² See the annex for an example of a [dashboard](#) of this kind, as used in the TNO Policy Game.

In general, when presenting results, it is important to keep an eye on the nuances, assumptions and bandwidths of the outcomes. Some tips in this respect:

- Do not present single outcomes; show the factors that have affected the outcomes and how they have done so.
- Main outcomes at a glance.
- Dials you can turn to show how these changes affect outcomes.
- Possibility of showing how input leads to outcome.

Here, it is always important to explain how a study has been conducted, including the assumptions that have been made during the study.

When recommendations are based on the outcomes of cost-benefit analysis, it is always useful to place the outcomes alongside the prioritisation of the goals in step 4.

References

Background documents (in Dutch) used during the draft of this phased plan that may be of interest for people who wish to read more.

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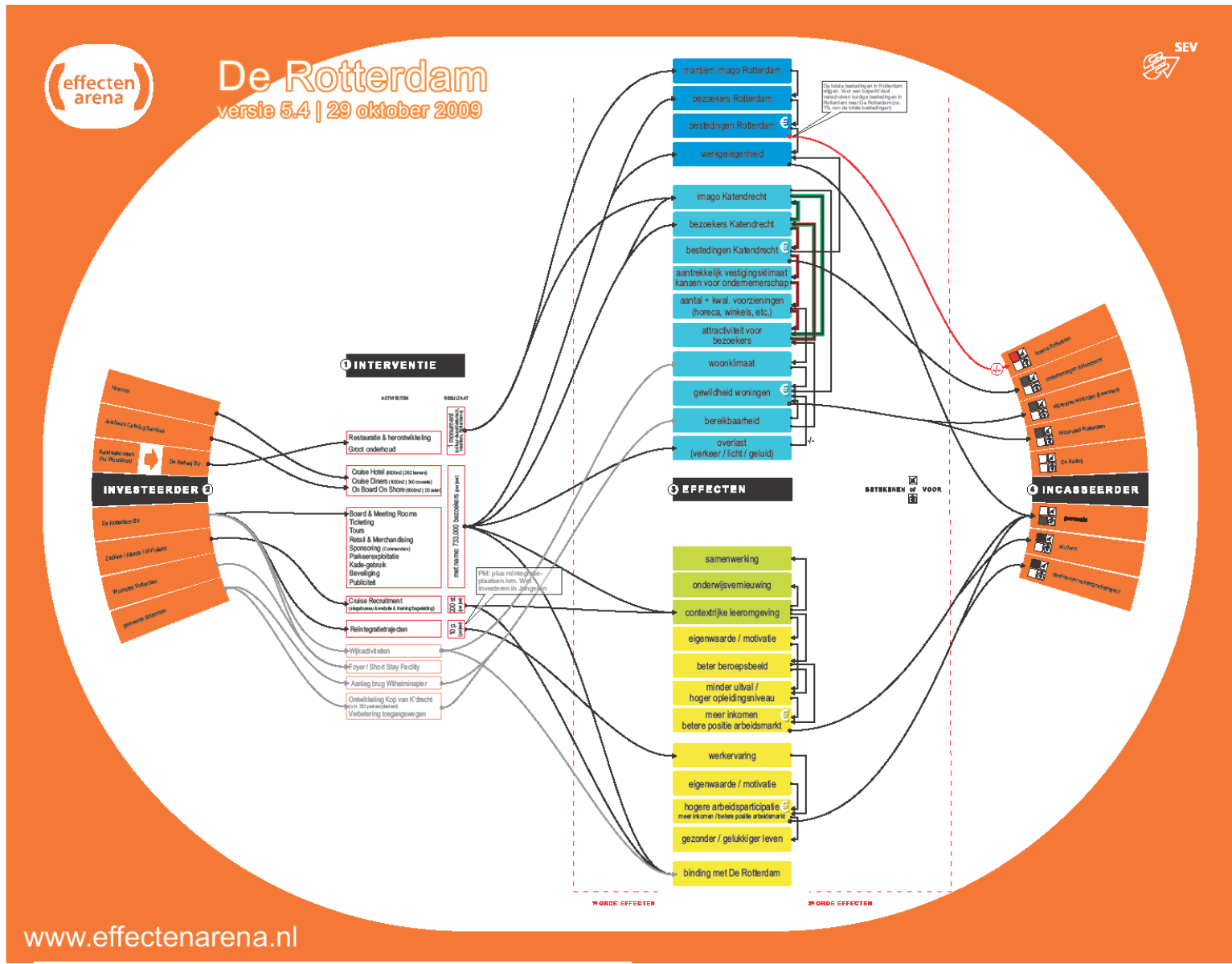
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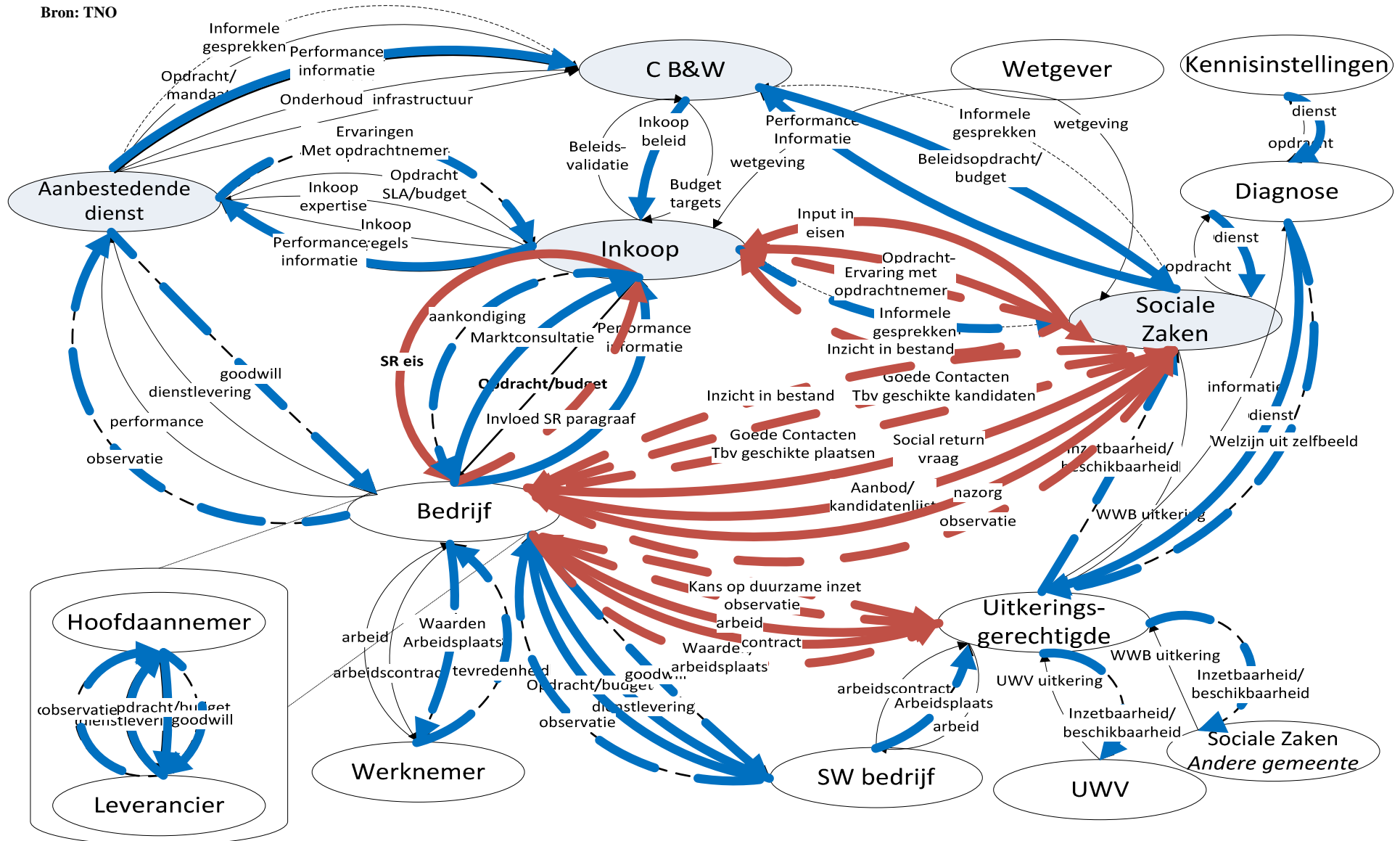
Annex – examples

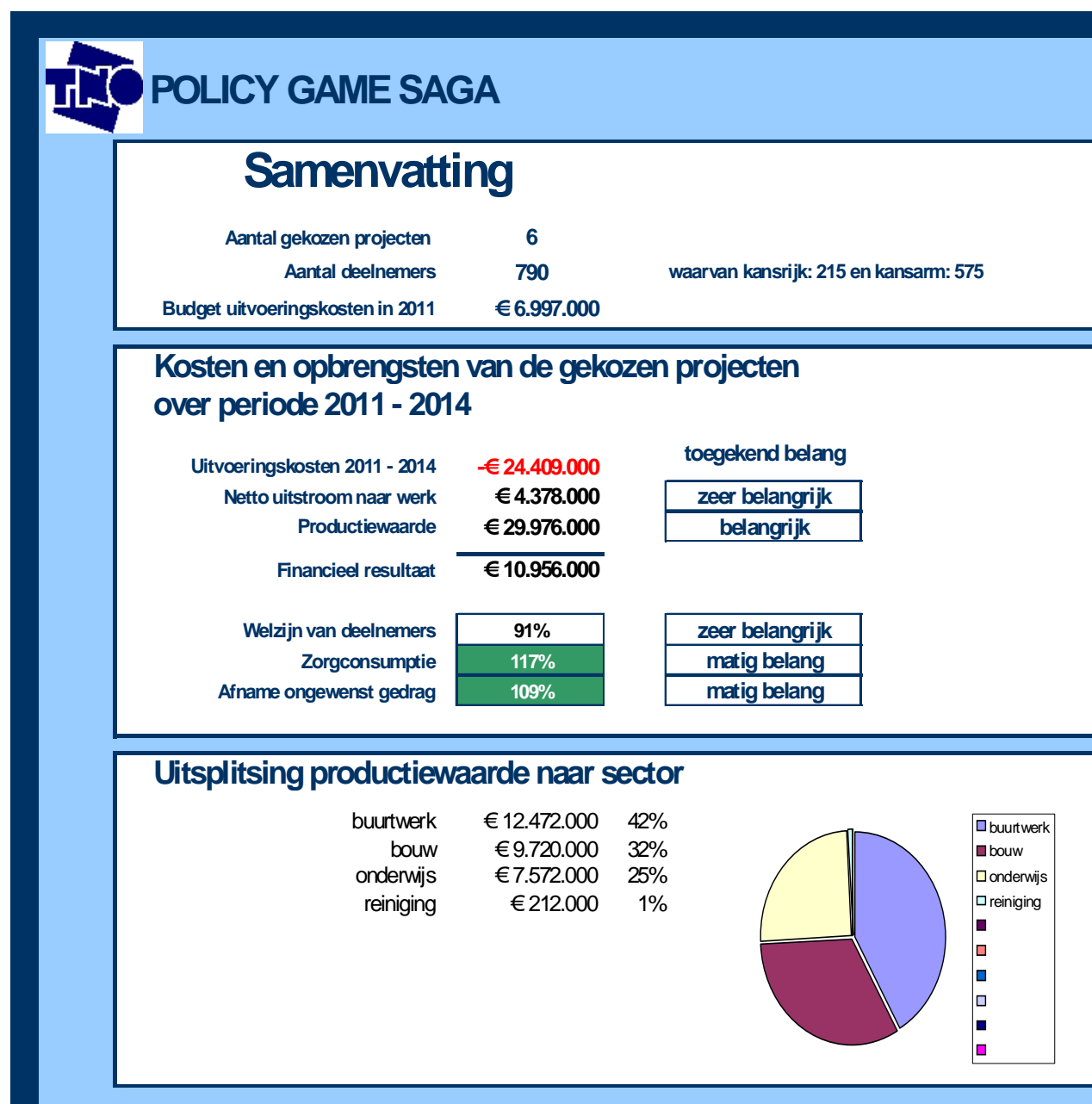
Example of impact arena (Case SS De Rotterdam)



Example of Value Network Analysis

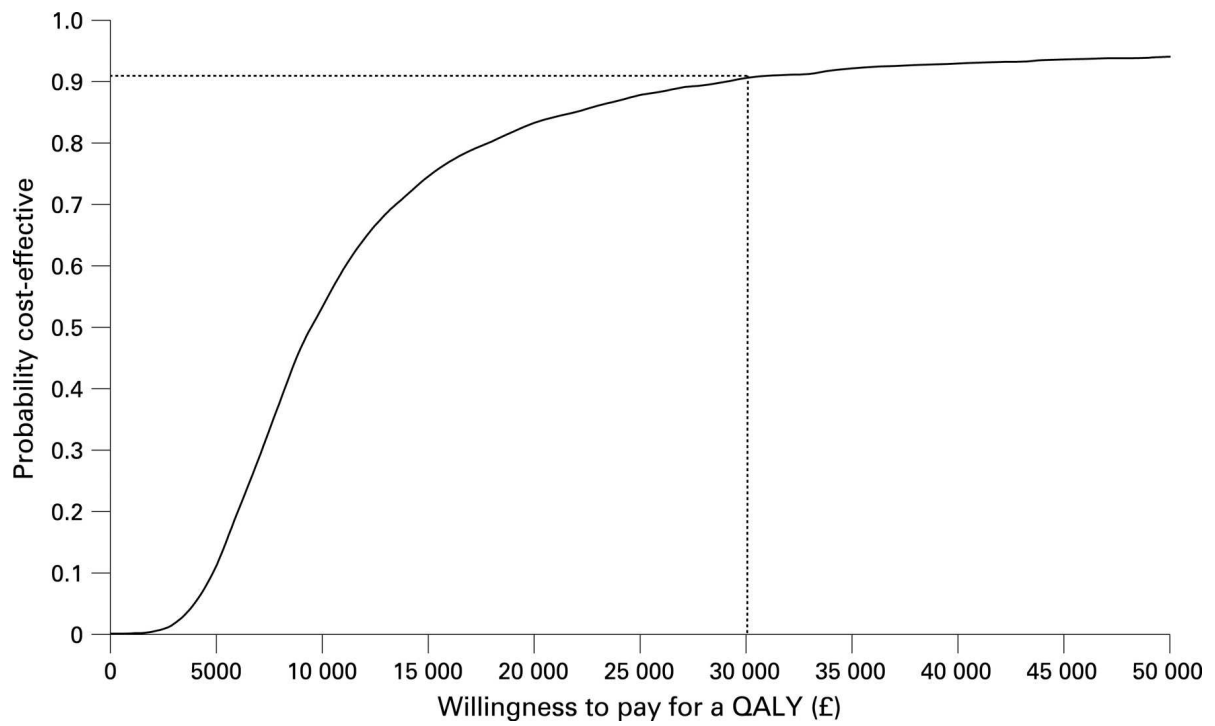
Bron: TNO





Bron: TNO

Example of acceptability curve (willingness to pay for a QALY).



Source: HEART, BMJ Group (<http://heart.bmj.com/content/94/12/1601.full.html>).