Slimme combinaties van infrastructurele- en ruimtelijke ontwikkeling - wat is het waard?

Anne Marel Hilbers – Rijksuniversiteit Groningen – a.m.hilbers@rug.nl
Frans Sijtsma – Rijksuniversiteit Groningen – f.j.sijtsma@rug.nl
Jos Arts – Rijkswaterstaat, Rijksuniversiteit Groningen – jos.arts@rws.nl

Bijdrage aan het Colloquium Vervoersplanologisch Speurwerk
24 en 25 november 2016, Zwolle

Samenvatting

Zowel in de wetenschappelijke literatuur als in de praktijk is er toenemende aandacht voor het koppelen en verknopen van ruimtelijke en infrastructurele ontwikkelingen. De meerwaarde van infrastructurele ontwikkeling met betrekking tot de gebieden die het beïnvloedt, lijkt de 'ruimtelijke fit' of configuratie waarin ze zijn ingebed. Een combinatie van infrastructurele en ruimtelijke maatregelen kan zorgen voor verhoging van de ruimtelijke kwaliteit van het gebied als geheel, vanuit de gedachte dat het koppelen van belangen en functies leidt tot meerwaarde. De bepaling van de meerwaarde van deze combinatie, ofwel 'toegevoegde ruimtelijke kwaliteit', is complex. Bestaande evaluatiemethoden blijken in de praktijk moeite te hebben de toegevoegde waarde te meten. Dit paper wil tot een analytisch kader komen om de evaluatiepraktijk te begeleiden bij het verminderen van een deel van deze complexiteit. We richten ons op het belang om consequent te streven naar 'consensus-based' gestandaardiseerde benchmarks die vergelijking tussen de verschillende transport infrastructuurprojecten mogelijk maken. Het doel van dit paper is dan ook het zoeken naar wat een methode nodig heeft om 'meerwaarde' consensus-based te bepalen, om vervolgens beter geïnformeerd te kunnen worden over de veronderstelde meerwaarde in de context van transport infrastructuur en gebiedsontwikkeling.

1. Introduction

Transport infrastructure requires large investments for construction prior to use, while impacts in areas is an incremental process. Infrastructure projects can be considered "as a single intervention in the infrastructure network, characterized by a fixed time schedule and dedicated budget" (Busscher, 2014, p. 123). This means that projects are not directly considered in relation to the network or the surrounding area, but mainly related to the pre-established frameworks. Important connections between the project and the remaining network and the surrounding area (Heeres et al., 2012), can be lost in this way. Partly because of this, gaining insight into the combination of these two can be difficult, and often is chosen for separation (Arts, 2016). This decision might be unfortunate as potential gain or added value might not be used and assessed. Assessing added value involves linking functional interrelatedness and multi-governance (Heeres et al., 2012).

In the Dutch context there is an ambition to promote the transformation to more integrated trade-offs focusing on the creation of synergies between land uses (e.g. Peek & Louw, 2008; Heeres et al., 2012). In the Dutch context there is an ambition to promote this transformation: "[t]hrough area oriented development, infrastructure can be combined with the improvement of spatial quality elsewhere, which makes that the spatial intervention becomes socially acceptable" (Elverding, 2008; p. 15). Given the above, measurement of added value when combining transport infrastructure and area development, is rather complex. Evaluating this added value requires planning tools and insight in current value quality. In practice, however, it proves difficult to measure the alleged added value. In this paper we distinguish this difficulty from a 'substance-oriented' perspective, such as environmental impact assessments, and from a 'process-oriented' perspective that facilitate interaction and consensus building among planners and stakeholders.

Table 1: Planning tools for integrating planning: a typology (after Runhaar et al., 2009)

Key aspects	First-generation, substance-oriented planning tools		Second-generation, process-oriented planning tools
	knowledge (eg indicators)	ex ante assessment (eg EIAs[a])	interactive planning tools (eg focus groups)
Main focus	Substance		Process
Main aim	Scientification: enhance knowledge base of planning; 'green' decision making		Socialization: facilitate interaction, shared visions and joint action
Main output	Knowledge on state of the environment. Predefined indicators	Knowledge on effects of future plans. Predefined indicators	Process management, outcomes are not known ex ante. No predefined indicators
Main assumptions	More (scientifically robust) knowledge results in better (greener) decisions	More (scientifically robust) knowledge results in better (greener) decisions	Interaction and negotiation result in learning, trust and support for action

[a] EIAs—environmental impact assessments

Tools developed on a *substance-oriented perspective* typically produce knowledge in the form of indicators, GIS, and so on, and of analytical tools for producing knowledge, such as EIAs or health-impact assessments for the identification (and mitigation) of environmental, health, and other effects of spatial developments. Other effects of spatial development include computer-based planning support systems (PSSs), covering a wide range of geoinformation technologies that can be used, among other things, to visualize environmental conditions or explore effects of spatial developments (Vonk, 2006). Although ten Heuvelhof and Nauta (1996) conclude that EIAs have had a significant influence on decision making in the Netherlands, in practice they are usually conducted at a relatively late stage of planning, often when the main decisions have already been made (Hildén et al, 2004). Regarding PSSs, it is observed that a large diversity of tools exists, but that these are underutilized in spatial planning practice (Vonk, 2006; Vonk et al, 2005).

From the 1990s onwards, planning tools have been developed that are more process oriented and that facilitate dialogues, building consensus and negotiating on adequate action plans (that is, interactive planning). The *process-oriented tools* are not always developed specifically for the integration of infrastructure- and spatial planning, but can nevertheless be used for this purpose (Amler et al, 1999; Valentin and Spangenberg, 2000). Their aim is to achieve consensus on a joint course of action and to stimulate the search for, and development of, creative solutions (Runhaar et al., 2009).

On the base of these two types of planning tools, we explore two challenges in finding a method in which 'value' consensus-based could be determined to guide the evaluation practice and reduce part of the complexity: *functional interrelatedness* (substance-oriented) and *consensus-based assessment* (process-oriented).

The aim of this paper is to seek what a method needs to determine added value consensus-based, in order to get better informed about the presumed added value in the context of transport infrastructure- and area development. We will first address the importance to understand added value by exploring *functional interrelatedness* (§2). Second, we explore traditional evaluation tools which assess transport infrastructure and spatial development separately, in order to distract common understandings and seek for *consensus-based assessment* (§3). Third, we will explore what this insights mean for the method we are seeking to *assess combined value* (§4). Fourth, we will work *towards a research agenda* (§5) which will be presented in paragraph 6.

2. Functional interrelatedness

Comprehensive plans are only feasible if potential synergies and added value can be made clear to planners and decision-makers from different sectors and organisations (Heeres et al., 2012). Therefore, this research strives for a better intersubjective underpinning to express synergy effects. An infrastructure network has no value without the link with the area where it provides access to. Added value development is the driver of the link between network and areas of different (spatial) scales. In other words, the network provides the link between the areas, and is also the driver for creating added value in, and of the areas. It is conventional in assessing value to divide the effects of an action into the costs of taking that action and the valued results that occur. Added value is created when the valued results are greater than costs used in producing the desired results. The dynamics of value assessment from infrastructure development is different from spatial development (Lenferink et al., 2014). So in the sectoral- and project-driven way of working (Glasbergen and Driessen, 2005; Banister et al., 2011; Heeres et al., 2012), the involved actors have a different, and often opposing, focus on the way value can be assessed. Bristow and Nellthorp (2000, p. 51) give a general view of European appraisal. They conclude that "there is a strong consensus on the treatment of a number of direct impacts, where money valuation and inclusion in cost benefit analysis is usual. There is less agreement on the treatment of environmental and social impacts".

Within infrastructure planning a development towards a more inclusive spatial development approach can be seen (Heeres et al., 2012). This approach aims to find synergies between network development and local quality. Following this development, there is a search for new revenue models at policy level. Stimulated by the financial and economic crisis, we look for opportunities to "do more with less" and to look at other ways of financing infrastructure (new revenue models). Combining functions and interests delivers added value. Currently this is mainly argumentative, without being based on hard data which show direct synergistic effects. To exploit the potential to create synergies by means of more integrated infrastructure developments, comprehensive sustainability analysis can help identify and evaluate "win-win" solutions. Integrated solutions, that are able to achieve multiple objectives are considered the most sustainable. Currently, the potential for the creation of synergy effects is expressed mainly through rhetoric arguments, without more objective evaluation (Beukers et al., 2012). Table 1 summarizes some key characteristic aspects of the fragmentation of planning cultures in two perspectives.

Table 2: Fragmentation of planning cultures: differences between infrastructure and land use planning (Heeres et al., 2016)

Classic infrastructure perspective (sectoral)	**Inclusive land use perspective**
Limited to directly affected area only	Involves indirectly affected area also
Technical, sectoral	Multifaceted, integral
Difficulties, risk assessment, resistance, need for mitigation, compensation	Possibilities, synergy, spin off
Institutionalised	Dynamic institutional landscape of stakeholders and coalitions
Positivist ontology: calculations, facts	Social-constructivist ontology: opinions, values, dialogue
Dominated by specialists	Dominated by generalists
Procedural, linear process	Network, organic, non-linear process

According to Heeres et al. (2016), in integrated planning approaches, the synergy between interrelated land uses may lead to the emergence of added value. Holland (1998) explains, in abstract terms, how added value emerges from the interaction between system elements. This reasoning assumes that the aggregated whole is more than the sum of its parts. Holland describes that such value is not present at the level of individual functions, but only when the systems are looked at as a coherent whole. In transport infrastructure planning, this implies that an integrated strategy combining specific sectoral interests not only leads to sectoral results. It also generates values that cannot be related to a specific sectoral action. This is why *relational geography* of key values (in the area) is needed in order to see the emergence of added value across sectors. In the next paragraph, we will explore how these insights are being used to make sense together.

3. Consensus-based assessment

The trend towards more integration and the call for more sustainable planning outcomes (Heeres et al., 2016; Litman, 2007), effects the use of ex ante evaluations and related instruments (Sijtsma et al, 2009). Different than in a traditional sectoral, infrastructure-oriented approach, where particularly 'hard' effects as travel time, traffic safety and flood risk play a role, within a more area-oriented approach, additional 'soft' values like environmental quality, social cohesion and cultural history values become more important (Sijtsma et al, 2009; Heeres et al., 2016). These more 'soft' values, with regard to the non-infrastructural land use functions, is often based on qualitative indicators such as sustainability, liveability, spatial quality, etc. (Heeres et al., 2016). This can cause problems within the planning process, because goals that can be expressed using concrete (quantitative) performance indicators are getting the most weight, goals that cannot be expressed in quantitative indicators are getting the least weight (Litman, 2007; Heeres et al, 2012; Heeres et al., 2016; Beukers et al, 2012; Sijtsma et al., 2009).

'Making sense together' expands on the common practice of consensus decision-making and creates a method for determining measurement standards for very ambiguous domains of knowledge, such as emotional intelligence, politics, religion, values and culture in general. From this perspective, the shared knowledge that forms cultural consensus can be assessed in much the same way as expertise or general intelligence. Reichert et al. (2015), argue that *intersubjective probabilities* (Gillies, 1991, 2000) provide the best framework for this purpose. We agree with Gillies (2000) on the need of a pluralist view of probability with different interpretations in different contexts. The subjective interpretation is important when describing individual beliefs and human behavior, whereas objective interpretations are fundamental to the natural sciences. To support decision making, we need a description of the best available knowledge. This knowledge is usually not perfect enough that intrinsic randomness, characterized by objective probabilities, is the only source of uncertainty. Therefore, ideally, we would like to describe the best available knowledge by intersubjective probabilities about which the community agrees.

Although there are convincing arguments for using (intersubjective) probabilities to describe knowledge, the limited capability of experts to quantify these probabilities and disagreements between experts can call for an extension to imprecise probabilities. The degree of imprecision can then be used to quantify the transition from cases in which quantitative decision support is suitable to cases in which the knowledge is insufficient (e.g. Rinderknecht et al., 2012). So to come to consensus-based assessment, meaningful and manageable information is needed. According to Reichert et al. (2015), successful implementation requires that the concepts are understandable to the decision makers and stakeholders and that the decision support process is well structured and moderated. In order to identify and structure meaningful and manageable decision support information, we will first elaborate on traditional evaluation tools which assess transport infrastructure and spatial development separately.

Sector specific assessment

Large infrastructure projects are traditionally subject of extensive *ex ante evaluations* in the field of environmental, social and economic levels. As we described in the introduction, classic infrastructure planning has a *rational rhetoric* when it comes to assessment and decision making. Decisions in transport infrastructure management need to be communicated and justified to 'the public'. This is facilitated by transparently conveying objectives and rational arguments of how these can best be achieved. This is the core of decision analysis or the theory of rational decision making (Keeney and Raiffa, 1976; Eisenführ et al., 2010) which is built on relatively simple rationality axioms. The concepts of rational decision making are often violated in actual human decision making. Alternative models have been suggested to better account for human behavior (Gigerenzer and Goldstein, 1996; Gigerenzer and Gaissmaier, 2011). Nevertheless, to structure the decision making process and to justify public decisions, rational arguments are important as they make the decision transparent, plausible and explicit. Thus, despite the deficiencies of rational decision theory as a behavioral theory, it is still preferable to behavioral theories when applied to support justifiable decision making in transport infrastructure management (see e.g. Arts, 1998).

Instruments such as Environmental Impact Assessment (see e.g. Arts, 1998), Social Impact Assessment (Vanclay and Esteves, 2011), (Social) Cost Benefit Analysis (see e.g. Boardman, 2006; Sijtsma, 2009) and more recently the Sustainability Check are known instruments to evaluate effects (De Jong and Van Wee, 2007; Heeres et al., 2015). In academic literature value is often used in different contexts and from different perspectives (Debreu, 1959; Miles, 1961; Moore, 1997; Stoker, 2006b). Value is used in the economic, but also the environmental and spatial domain. When we consider the concept of value in the context of infrastructure, it is often framed in terms of cost optimization or delivery of economic gains for mobility and transportation (Arts, 1998). Cost optimization is often covered in literature in terms of asset management, whole life costing and design methodologies (Boussabaine & Kirkham, 2004; Hale et al., 2008; Hooper, 2009; Miles, 1961; Scholtes, 2010). Expressing value in terms of economic or financial gains is mostly done through the use of cost-benefit analysis (CBA) for transportation studies (Gille, Harmsen, & Minne, 2010; Litman, 2009; Minvielle, 2007; Mishra, Khasnabis, & Swain, 2013; F. A. Ward, 2009).

Spatial development projects are mostly subject of *business case* analysis, with a more *normative and relational rhetoric*. Recently, in the Netherlands, a distinct type of 'hybrid' planning tool has been developed specifically for defining area-based environmental ambitions in spatial plans, coupled with the development of measures for attaining these ambitions (Runhaar et al., 2009). However, little research has been conducted into how these planning tools perform in practice and how this can be understood, especially in comparison with more traditional 'substance-oriented' and 'process-oriented' planning tools. According to Verburg et al. (2004a), the spatial configuration of land use is an important determinant of many ecological and socioeconomical processes (Lambin et al, 2001). A better understanding of the determinants of the spatial configuration of land use is necessary to assess the impact of possible, future developments on environment, economy, and society at large. The task of modelling sociocultural forces is difficult because humans act both as individual decision makers (as assumed in most econometric models) and as members of a social system. Sometimes these roles have conflicting goals. Similar scale dependencies are found in biophysical processes: the aggregated result of individual processes cannot always be straightforwardly determined (Verburg et al., 2014b). Table 2 summarizes some key characteristic aspects of the two sectors.

Table 3: Characteristics of the two sectors

	Infrastructure projects	**Spatial development projects**
Tradition	Ex ante evaluations	Business case
Logic	Rational	Normative
Instruments	Social Impact Assessment, (Social) Cost-Benefit Analysis, Sustainability Check	Land Use Assessment
Common ground	MER (Environmental Impact Assessment)	

So integration of traditionally separate spatial interventions (i.e. interventions in infrastructure, housing, water or nature) offers opportunities for “scope optimization, with lucrative and non-cost-effective spatial investments at regional level linked together” (Priemus, 2002, p. 461). This implies the existence of opportunities for plans with *lower costs and equal functionality*, *equal costs and higher functionality*, or *higher perceived value* (De Jong and Spaans, 2009; Hijdra, 2013). According to Heylighen (2001), a configuration can be called a ‘fit’ when it is able to maintain or grow the specific configuration of his surroundings. An unsuitable configuration, on the other hand, is one that spontaneously disintegrates under the given boundary conditions. Different configurations can be compared to their level of “fitness”, or probability of survival under the conditions given by the surroundings. Thus, adaptivity can be understood as the attainment of a ‘fit’ between the infrastructural- and spatial components in the area. So the momentum created by adequate and efficient road infrastructure developments may function to eventually arrive at a win-win situation, in which all actors involved somehow benefit from a project (Rakers et al., 2010). This is why a better understanding of value changes (in the area) of the different components is needed in order to *make sense together*. In the next paragraph, we will explore what these insights mean for the method we are seeking to *assess combined value.*

4. Assessment of combined value

To get a better understanding of the combined value is to link multi-scale characteristics (e.g. functions and interests) of (sub)components (spatial or infrastructural) in order to find out whether the configuration of (sub)components complements and/or contradicts one another. In order to do this, we first want to address the importance of the concept of spatial quality when combining transport infrastructure and spatial development.

Spatial quality is a difficult to define concept. Like many others who have to negotiate this difficult concept, we therefore refer to the Roman architect Vitruvius (undated, first century BC), who stated that a good design meets three key criteria at the same time: utilitas (or: functionality), firmitas (firmness or solidity) and venustas (beauty or attractiveness). In its simplicity, this always applies. But its translation to a specific design challenge is not without difficulty. The Vitruvian values of "utilitas, firmitas and venustas" are central in spatial development, and can be translated to the pillars of utility, perceived and future values (Hooimeijer, Kroon & Luttik, 2007, p. 10; VROMraad, 2011).

According to Moulaert et al. (2013), although there is a broad agreement on the importance of spatial quality as an analytical concept and a category for planning, design and policy-making, different user, practice and research communities tend to have different views on what makes a certain spatial configuration 'qualitatively' rich — by itself or compared to others. Miciukiewicz et al. (2010) found that major theoretical and operational approaches to the concept of spatial quality do not define 'spatial quality' nor 'quality' in an explicit way (Miciukiewicz et al., 2010). Dimensions and concepts of spatial quality in the literature include ideas about 'good design' (Sternberg, 2000), 'universal design', 'human scale', 'good architecture' (Chapman and Larkham, 1999; Trip, 2007), 'planning performance' (Friedmann, 2004), 'effective planning process', 'good planning process' (Conroy and Berke, 2004), 'quality planning' (Creedy et al. 2007), 'place quality' (Healey, 2004), 'spatial justice' (Soja, 2010), 'fulfillment of human needs' (Moulaert, 2009) or 'inclusive design' (Lang, 1990). The reading and assessment of the quality of a space or a place are not based upon value intrinsic to objects (and idealizations of these objects), but upon experiential value of these objects, which is identified by perceiving, thinking, sensitive and socialized subjects whose intersubjective perceptions are relational (e.g. Moulaert et al., 2013; Heeres et al., 2016). "Personal and collective interest in particular features of spatial quality depends on the nature of the experienced objects, as well as on the cultural, class, racial and gendered identities and spatial competences of experiencing subjects" (Moulaert et al., 2013). So the intrinsic multidimensionality of spatial quality means that we need a intersubjective, context dependent framework to stimulate thoughts, but also to arrange and order them.

5. Towards a research agenda

According to Heeres et al. (2016), to effectively implement area-oriented infrastructure planning, it is necessary to cover a wider perspective on integrated planning and to explore subsequent steps. Examples are assessment of the created synergies for decision-making purposes (decision support instruments), or the exploitation of these values through applying value capture mechanisms. Decision-making usually focuses on the choice among alternatives. According to Keeney (1996), "focusing on alternatives is a limited way to think through decision situations. It is reactive, not proactive. (…) It is values that are fundamentally important in any decision situation. Alternatives are relevant only because they are means to achieve your values." (Keeney, 1996, p. 537). So alternative-focused thinking is designed to solve decision problems. Value-focused thinking is designed to identify desirable decision opportunities and create alternatives. According to Keeney (1996), "significant effort is allocated to make values explicit.

Logical and systematic concepts are used to qualitatively identify and structure the values appropriate for a decision situation" (Keeney, 1996; p. 538).

The proposed framework aims to meet this assumption. Based on our analysis on functional interrelatedness, consensus-based assessment and assessment of combined value we distinguish three key elements in order to structure the framework: relational geography, making sense together and integrated tradeoffs between alternatives.

Relational geography

According to Portugali (2006), the academic debate on structuralist and post-structuralist ideas about geography proposes two relevant understandings of space. Within a conventional 'territorial' understanding of space, spatial scales are considered 'relatively stable, nested geographical arenas' (Brenner, 1998; Heeres et al., 2016). Places subsequently derive their identity from their position within these cascaded spatial containers (Brenner, 2003; Bulkeley, 2005). However, in the rise of post-structuralist thinking, geographers have arrived at the conclusion that places derive their identity not merely form their nested position in geographical scales, but rather from 'engagements' with other places (Murdoch, 2006). Following this argumentation, spaces and places do not have singular identities but can have multiple identities, derived from their relations with other places (Amin, 2004; Bulkeley, 2005). Within such a relational perspective, spatial elements become nodes in webs of relations, connecting various spatial scales (Graham & Healey, 1999; Allen et al., 2002). Places thus derive their identity from the various networks – including infrastructures for communication and transportation, but also e.g. social, ecological and economic networks with local, regional or national widths – that overlap in a place (Castells, 2000).

Making sense together

From our analysis on consensus-based assessment, the key value-creating aspect of infrastructure development in relation to the areas it affects seems to be the areal fit or configuration they are embedded in. A combination of infrastructural and spatial measures may ensure increase of the spatial quality of the area as a whole from the idea that linking interests and functions leads to added value (Elverding, 2008; Heeres et al., 2012). So in order to make sense together, it is important to understand value changes per component.

Integrated tradeoffs of alternatives

According to Reichert et al. (2015), a crucial element for any decision support methodology is the prediction of the consequences of the alternatives. This can be done by transferring knowledge from similar systems, eliciting expert opinions about effects of alternatives, applying mathematical models (elements of which may also have been elicited from experts). According to Zeleny (2008), multiple criteria or objectives can never be conflicting per se because their properties emerge only when applied to different sets of alternatives. It is not the criteria, measurement or evaluations that are primary in determining decision quality – it is the configuration of the feasible set of available alternatives. Criteria are only 'measure tapes' and no trade-offs can exist among them. “Decision making is a function beyond measurement and search, aimed at managing, resolving or dissolving the conflict of trade-offs” (Zeleny, 2011; p. 79). According to Zeleny (2011), optimization must involve design of the configuration or ‘shape’ of sets of alternatives because no given and fixed system can be optimized. Traditional ‘optimization’ is therefore measurement and search, or just computation. Anything given and fixed a priori cannot be optimized. It is important to appreciate at least four principles informing the concept and attributes of trade-offs (Zeleny, 2011):

1) Trade-offs are the properties of the means (sets of alternatives), not of criteria or objectives.
2) Criteria are merely measures or ‘measure tapes’ for evaluating (measuring) objects of reality (things, alternatives, options, or strategies). There is a fundamental difference between employed measures, measured objects and interaction of measures.
3) There are no trade-offs between measures (or measure tapes). Measures of cost and quality do not produce trade-offs—the set (or configuration) of measured choices (alternatives, options) does.
4) It is the configuration (shape, structure) of the feasible set of alternatives that produces or brings forth all trade-offs.

To come to a win-win solution, or ‘fit’ in the decision-making process, the next step is to consider multiple objectives at a time and try to generate alternatives that would be good for several stakeholders. These alternatives are likely to be refinements or combinations of those created using single objectives. They should be the basis for the time and effort we spend thinking about decisions. So what is needed is to understand tradeoffs between values for decision making. This way we will elaborate on what ‘catches’ in terms of knowledge.

6. Research agenda

The aim of this paper was to seek what a method needs to determine added value consensus-based, in order to get better informed about the presumed added value in the context of transport infrastructure- and area development. On the basis of our literature review three kinds of understandings seem to be important: 1) understanding key values of the area and the infrastructure network; 2) understanding value changes per component; and 3) understanding tradeoffs between values for decision making. We conceptualized these understandings in the framework below.

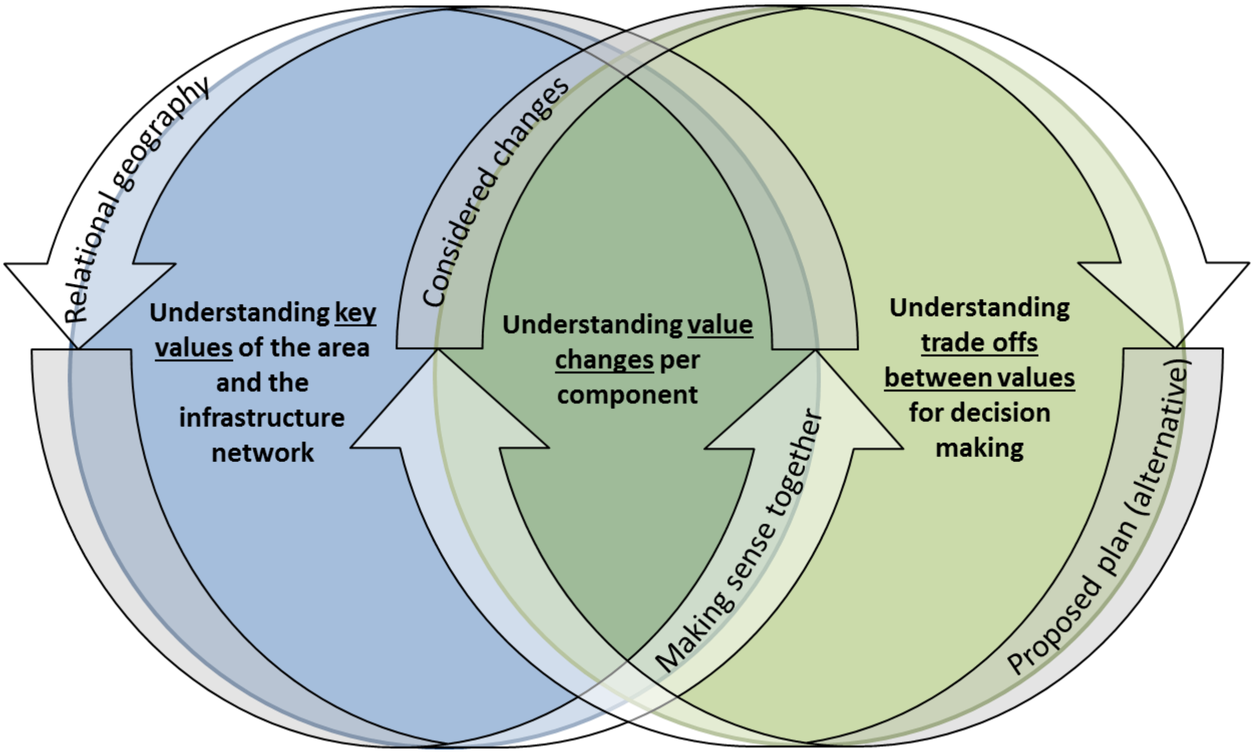

Figure 1: Analytical framework of understandings

Understanding key values of the area and infrastructure network

As mentioned before, a proposed transport infrastructure plan (alternative) touches a spatial area and an infrastructure network. To get a better key understanding of this area and network, experimenting with relational geography (by mapping) can give insight into related spatial components, connecting various spatial scales.

Understanding value changes per component

This understanding is positioned in the middle of the figure, and touches all the arrows. To make sense together after understanding the key values of the area and the infrastructure network, value changes can offer considerable changes to the proposed plan after experimenting with combining (spatial) components.

Understanding tradeoffs between values for decision making

A proposed transport infrastructure plan, as an alternative, starts in this understanding. The proposed plan has been subject to tradeoffs between stakeholders and thus different values and interests. Ideally, in a method where the consensus-based integration of infrastructure and spatial development can be assessed, these alternatives will be examined through value changes when combining components. After understanding what changes, considerable changes can be adapted to the proposed plan.

The above framework can serve as input for a research agenda to meet the challenges in consensus-based value assessment in combined transport infrastructure- and spatial development.

Literatuur

- Amler, B., & Deutsche Gesellschaft für Technische Zusammenarbeit. (1999). *Land use planning : Methods, strategies and tools*(Schriftenreihe der GTZ, Nr. 268; Schriftenreihe der Deutschen Gesellschaft für Technische Zusammenarbeit, 268). Wiesbaden: Universum Verlagtalt.
- Arts, J. (1998). *EIA follow-up : On the role of ex post evaluation in environmental impact assessment.*Groningen: Geo Press.
- Arts, J. (2016). *Builders and planners. Infrastructure and spatial planning in the Netherlands 1920-2015.*Delft: Uitgeverij Eburon.
- Banister, D. (2008). The sustainable mobility paradigm. Transport Policy, 15(2), 73-80.
- Banister, D. (2011). The trilogy of distance, speed and time. *Journal Of Transport Geography*, *19*(4), 950-959.
- Bartholomew, K. (2007). Transportation, 34, 397.
- Beukers, E., Bertolini, L., & Te Brömmelstroet, M. (2012). Why Cost Benefit Analysis is perceived as a problematic tool for assessment of transport plans: A process perspective. *Transportation Research Part A*, *46*(1), 68-78.
- Boardman, A., Vining, A., & Waters, W. G. (1993). Costs and Benefits through Bureaucratic Lenses: Example of a Highway Project. Journal Of Policy Analysis And Management, 12(3).
- Bristow, A. L., & Nellthorp, J. (2000). Transport project appraisal in the European Union. *Transport Policy*, *7*(1), 51-60.
- Busscher, T., Arts, J., & Rijksuniversiteit Groningen. (2014). *Towards a programme-oriented planning approach : Linking strategies and projects for adaptive infrastructure planning.*Groningen: Rijkversiteit Groningen.
- Castells, M. (2010). Globalisation, Networking, Urbanisation: Reflections on the Spatial Dynamics of the Information Age. *Urban Studies*, *47*(13), 2737-2745.
- Eisenführ, F., Weber, M., & Langer, T. (2010). *Rational decision making.* Berlin: Springer.
- Elverding (2008). Sneller en beter. Adviesrapport Commissie Elverding.
- Flyvbjerg, B., Bruzelius, N., and Rothengatter, W. (2003), Megaprojects and Risk: An Anatomy of Ambition, Cambridge, Cambridge University Press.
- Flyvbjerg, B. (2009). Survival of the unfittest: why the worst infrastructure gets built-and what we can do about it. Oxford Review Of Economic Policy, 25(3), 344-367.
- Gigerenzer G, & Goldstein DG. (1996). Reasoning the fast and frugal way: models of bounded rationality. *Psychological Review*, *103*(4), 650-69.
- Gigerenzer, G., & Gaissmaier, W. (2011). Heuristic Decision Making. *Annual Review Of Psychology*, *62*(1), 451-482.
- Gillies, D. (1991). Intersubjective Probability and Confirmation Theory. *The British Journal For The Philosophy Of Science*, *42*(4), 513-533.
- Gillies, D. (2000). *Philosophical theories of probability*(Philosophical issues in science; Philosophical issues in science). London: Routledge.
- Glasbergen, P., & Driessen, P. P. J. (2005). Interactive planning of infrastructure: the changing role of Dutch project management. *Environment And Planning C: Government And Policy*, *23*(2), 263-277.

- Heeres, N., Tillema, T., & Arts, J. (2012). Functional-Spatial Sustainability Potentials of Integrated Infrastructure Planning. Procedia - Social And Behavioral Sciences, 48, 2533-2544.
- Heeres, N., Tillema, T., & Arts, J. (2016). Dealing with interrelatedness and fragmentation in road infrastructure planning: an analysis of integrated approaches throughout the planning process in the Netherlands. *Planning Theory & Practice*, *17*(3), 421-443.
- Heuvelhof, E. F. t., & Nauta, C. M. (1996). *(M)erkenning : Onderzoek naar de doorwerking van m.e.r*(Achtergrondstudie / Evaluatiecommissie Wet Milieubeheer, nr. 28; Achtergrondstudie). Den Haag: Evaluatiecommissie Wet Milieubeheer.
- Hijdra A. (2013). Messing about on the rivers. *Economist (United Kingdom)*, *406*(8824).
- Hildén, M., Furman, E., & Kaljonen, M. (2004). Views on planning and expectations of SEA: the case of transport planning. *Environmental Impact Assessment Review*, *24*(5), 519-536.
- Holland, J. H. (1998). *Emergence : From chaos to order.* Oxford: Oxford University Press.
- de Jong, J., & Spaans, M. (2009). Trade-offs at a regional level in spatial planning: Two case studies as a source of inspiration. *Land Use Policy*, *26*(2), 368-379.
- Keeney, R. L., Raiffa, H., & Meyer, R. F. (1976). *Decisions with multiple objectives : Preferences and value tradeoffs*(Wiley series in probability and mathematical statistics; Wiley series in probability and mathematical statistics). New York, NY etc.: Wiley.
- Leendertse, W., Lenferink, S., & Arts, J. (2012). Public-Private Collaboration: How Private Involvement can Contribute to Network Performance. Procedia - Social And Behavioral Sciences, 48, 2917-2929.
- Lenferink S., Arts J., Tillema T., & Leendertse W. (2014). Public-Private Plan Development: Can Early Private Involvement Strengthen Infrastructure Planning? *European Planning Studies*, *22*(2), 323-344.
- Moore, M. H. (2014). Public Value Accounting: Establishing the Philosophical Basis. Public Administration Review, 74(4), 465-477.
- Moulaert, F., Van Dyck, B., Khan, A. Z., & Schreurs, J. (2013). Building a Meta-Framework to 'Address' Spatial Quality. International Planning Studies, 18(3-4), 389-409.
- Peek, G.-J., & Louw, E. (2008). Integrated Rail and Land Use Investment as a Multi-disciplinary Challenge. *Planning Practice And Research*, *23*(3), 341-361.
- Priemus, H. (2002). Public-Private Partnerships for Spatio-economic Investments: A Changing Spatial Planning Approach in the Netherlands. *Planning Practice And Research*, *17*(2), 197-203.
- Portugali, J. (2006). Complexity theory as a link between space and place. *Environment And Planning A*, *38*(4), 647-664.
- Reichert P., Langhans S.D., Lienert J., & Schuwirth N. (2015). The conceptual foundation of environmental decision support. *Journal Of Environmental Management*, *154*, 316-332.
- Rijkswaterstaat (2015). Networking for Urban Vitality.

- Rinderknecht, S. L., Borsuk, M. E., & Reichert, P. (2012). Bridging uncertain and ambiguous knowledge with imprecise probabilities. *Environmental Modelling And Software*, *36*, 122-130.
- Runhaar H., Driessen P.P.J., & Soer L. (2009). Sustainable urban development and the challenge of policy integration: An assessment of planning tools for integrating spatial and environmental planning in the Netherlands. *Environment And Planning B: Planning And Design*, *36*(3), 417-431.
- Sijtsma, F. J. (2009). *Natuureffecten in de MKBA's van projecten voor integrale gebiedsontwikkeling*(Beleidsstudies / Planbureau voor de Leefomgeving). Bilthoven etc.: Planbureau voor de Leefomgeving.
- Valentin, A., & Spangenberg, J. H. (2000). A guide to community sustainability indicators. *Environmental Impact Assessment Review*, *20*(3), 381-392.
- Vanclay, F., & Esteves, A. M. (2011). *New directions in social impact assessment : Conceptual and methodological advances.*Cheltenham: Edward Elgar.
- Verburg, P. H., Eck, J. R. R. v., Nijs, T. C. M. d., Dijst, M. J., & Schot, P. (2004a). Determinants of land-use change patterns in the Netherlands. Environment And Planning B: Planning And Design, 31(1), 125-150.
- Verburg, P. H., Schot, P. P., Dijst, M. J., & Veldkamp, A. (2004b). Land use change modelling: current practice and research priorities. *GeoJournal : An International Journal On Human Geography And Environmental Sciences*, *61*(4), 309-324
- Vonk, G., Geertman, S., & Schot, P. (2005). Bottlenecks blocking widespread usage of planning support systems. *Environment & Planning A*, *37*(5), 909-924.
- Vonk, G. A. (2006). *Improving planning support : The use of planning support systems for spatial planning*(Netherlands geographical studies, 340; Nederlandse geografische studies, 340). Utrecht: Koninklijk Nederlands Aardrijkskundig Genootschap.
- Zeleny, M. (2011). Multiple Criteria Decision Making (MCDM): From Paradigm Lost to Paradigm Regained? Journal Of Multi-Criteria Decision Analysis, 18(1-2), 77-89.