

National road network development in a local spatial context – 8 lessons for area-oriented infrastructure planning

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Samenvatting

Dit paper presenteert 8 lessen voor een gebiedsgerichte aanpak bij de planning van snelwegen. Deze lessen vormen de praktische aanbevelingen van een onderzoek naar planning op het raakvlak van snelweg en omgeving.

In toenemende mate ervaren snelwegprojecten problemen met tijd, geld en kwaliteit ten gevolge van wisselwerking tussen snelweg en omliggende functies als wonen, werken, natuur en recreatie. Om met die problemen om te gaan verandert de manier waarop vraagstukken op dit raakvlak worden aangepakt: van het mitigeren en compenseren van negatieve effecten (lijngerichte planning), naar steeds meer het benutten van positieve effecten (een gebiedsgerichte aanpak). Waar een lijngerichte benadering het belang van het transportnetwerk als uitgangspunt neemt, integreert een gebiedsgerichte benadering het netwerkbelang en het belang van de lokale omgeving. Gebiedsgerichte planning streeft het verbeteren belangen op alle schaalniveaus: voor het netwerk, regionaal en lokaal. Er wordt actief gezocht naar win-win situaties.

Integratie van snelweg en omgeving kan een antwoord zijn op de verbondenheid van snelweg en omgeving en de daaruit voortvloeiende afhankelijkheid van actoren. Die afhankelijkheid vraagt om samenwerking. Dat is echter nooit eenvoudig. Planning op dit raakvlak vindt plaats in een sterk gefragmenteerde institutionele context: actoren op netwerkschaal werken samen met regionale en lokale actoren, elk met eigen verantwoordelijkheden, procedures en beleid. Uiteenlopende referentiekaders en opvatting over planning en ruimtelijke ordening bemoeilijken de samenwerking verder.

De toepassing van een gebiedsgerichte benadering is dan ook een afweging. In hoeverre vraagt de opgave om integratie? En vervolgens, welke functies neem je, hoe baken je het gebied af en hoe richt je de samenwerking tussen verantwoordelijke partijen in? Dit paper stelt een proces van zes stappen voor om met dat soort vragen om te gaan. Dit proces is iteratief en biedt handvatten om bij iedere detailleringstap van een project een passende afweging te maken. Om dit proces in de praktijk te brengen worden acht aanbevelingen gedaan.

Bij de toepassing van dit proces is het belangrijk om in het achterhoofd te houden dat gebiedsgerichte planning niet alleen gaat om externe integratie met andere ruimtelijke functies. Interne integratie, binnen de transportsector (onderliggende wegennet, openbaar vervoer, vormen van mobiliteitsmanagement) is minstens zo belangrijk. Een sterke externe focus zorgt voor mooie inpassingen. Echter, zonder aandacht voor interne integratie is de duurzaamheid en houdbaarheid van dit soort oplossingen kwetsbaar. De combinatie van externe en interne integratie vergroot niet alleen de robuustheid van een transportsysteem, het versterkt ook de sociaaleconomische waarde van plannen.

1. Introduction

This paper presents 8 lessons for area-oriented infrastructure planning. These lessons are based on a study about highway infrastructure planning in the Netherlands.

Rijkswaterstaat, the Dutch agency for public works and water management, is searching to renew the balance between infrastructure and environment. In an interview, the director-general of the organization stated:

'The next step is linking infrastructure to spatial projects: combining various spatial challenges into full area developments in order to not only realize road infrastructure ambitions, but also to reshape the areas that surround the road and to establish logical relations with energy, recreation and liveability' (translated from Jan Hendrik Dronkers, in an interview with Koenen, 2014).

With this statement the director-general of Rijkswaterstaat (RWS) firmly states the renewal of the organisation's course that took place over the past decade (see also Bayer, 2014). This course concerns the implementation of the Dutch national policy on road infrastructure planning by means of so-called "area-oriented strategies" (Teisman & Klijn, 2002). Within this policy, mobility is considered a necessary condition for economic growth and social quality, albeit within environmental boundaries, and the realization and modification of a well-functioning road infrastructure network is promoted (V&W, 2006). Organizations such as the OECD (2011) stress the necessity of a well-functional highway infrastructure network for socio-economic development.

However, area-oriented planning is challenging. It requires public-public cooperation between governmental layers – national, regional and local governments – but also market parties and interest groups. These organizations are also strongly fragmented.. In order to be able to make well-grounded choices about when and how to apply area-oriented strategies effectively, more insight is needed into the interrelatedness of land uses and the interaction between responsible actors. To that end, a study was done on the application of area-oriented approaches in highway planning, which had the objective:

To provide directions for the application of area-oriented strategies in road infrastructure planning through gaining insights into the potential (dis)advantages of infrastructure-land use integration and by exploring creation, assessment and exploitation of added value.

This paper presents the main outcomes of this study, which took place from 2010 onwards as a PhD-project. The research comprised of multiple case studies of major infrastructure projects in the Netherlands. Additionally, scientific literature and policy documents were studied. The study took place in close cooperation with Rijkswaterstaat.

The aim of this paper is to discuss the main lessons that can be drawn for infrastructure planning. After this introduction, the next section elaborates on the background of area-oriented planning. Section 3 discusses the main findings of the study. At this a differentiation will be made between the choice for area-oriented strategies and the operationalization of these strategies. In the final section, these findings are brought

together and 8 lessons for national road network development in a local spatial context are presented.

2. Backgrounds: a new perspective on highway planning

The main topic of the study is the interface between highways that are part of large scale networks and land uses with a local or regional character. Within the context of contemporary planning, the contrasts at this interface ask for a new perspective on infrastructure planning.

2.1 Interrelatedness and interdependence at the infrastructure-land use interface

Highway infrastructures are part of large national or international transportation networks. The main purpose of these networks is efficient transportation: highways accommodate vast capacities, high speeds and long distance travel. In addition to being part of national or international networks, highways are also an element in other networks. At the local scale, highways are one of the elements of the spatial system of an area. Together with other land uses, such as housing, recreation, business, agriculture, local transport provisions, etc., highways define the spatial structure and layout of areas (Neuman, 2006). At the regional level, highways are part of the daily urban system. As part of multiple spatial networks, at multiple spatial scales, highways are strongly interrelated with other land uses. This has negative (environmental impacts on sensitive land uses), as well as positive impacts (enhancing accessibility and thereby socio-economic development).

Functional and spatial interrelatedness

This interrelatedness is functional as well as spatial. Functional since highways and other land uses actually influence each other's quality. Think of the interchange of traffic between highways and local infrastructure. Or the barrier effect that highways have as they cut through the old structures of areas (neighbourhoods, landscape, nature). Spatial, since the land uses often are physically close to each other or, even, claim the same space – see Figure 1; see also Arts (2007).



Figure 1. In Maastricht the interrelatedness of highway and surrounding area is functional and spatial. Functional since the road is an important traffic artery for the city, but also a

barrier between the eastern and western part of Maastricht. Spatial since highway and surrounding areas have long been too close to each other, causing severe liveability and safety issues.

This interrelatedness is not something new. However, a change may be noticed in how planners experience the interrelatedness of highway infrastructures and other land uses. In the early days of highway planning, highways were developed as parkways for the purpose of enjoying glorious landscape (Shannon & Smets, 2010; Arts et al., 2016). From the 1970s onwards, environmental awareness grew. Protecting the surrounding landscape against adverse effects of infrastructure became the new perspective. In the current context, the interrelatedness between highways and environment has become so strong that over time wicked conflicts lead to loose-loose situations or lock-ins. Many examples of cost and time overruns, related to conflicts between highways and surrounding areas, can be found in the infrastructure planning of the past decades.

Need for public-public cooperation

Due to the interrelatedness of land uses, the policy domains at the infrastructure-land use interface are interdependent. Interdependence implies that for achieving their objectives policy makers and planners need to cooperate with others. For infrastructure planning this means that cooperation with other stakeholders at the infrastructure-land use interface (or co-production) is a necessary precondition for infrastructure projects.

2.2 A changing perspective: from line- to area-oriented planning

The context of strong functional and spatial interrelatedness asks for a renewed approach. Conventionally, the highway planning has a strong inward focus. Infrastructure realization is the main interest of this 'line-oriented-approach'. Other land uses are of secondary importance. Consequently, dealing with external effects is limited to mitigating and compensating for negative environmental effects.

Strong functional and spatial interrelatedness and the interdependence of stakeholders changes the balance between land uses infrastructure projects. This complex context requires an adjusted planning perspective (Heeres et al, 2012). Within such 'area-oriented approaches' land uses at the local or regional scale are as important as the infrastructural interest. This expands the scope of highway projects. Other land uses become part of the primary objective of highway projects. Area-oriented highway projects with a dual objective pursue 'win-win situations': improvements to the infrastructure network are combined with improvements to local and regional land uses. This adjusted objective must be seen as an expanded perspective. In area-oriented approaches the pursuit of win-win situations stands next to protection against adverse environmental effects.

2.3 A challenging institutional context

Over the past century highway planning has grown into a separate policy silo. This means that policy making, as well as the actual planning and realization are done by specific institutions. In the Netherlands, for example, infrastructure policy has long been prepared by a specific ministry, in targeted policy documents. These policy instructions

are carried out by a dedicated planning organization. The main concern of these organizations is the performance of the highway networks at the national scale.

Policy making for land uses at the regional and local scale is often done by provinces and municipalities. These governmental layers instruct their own organizations for project implementation and for management and maintenance of their land use interests. Figure 2 is a schematic illustration of the fragmented institutional landscape at the infrastructure-land use interface.

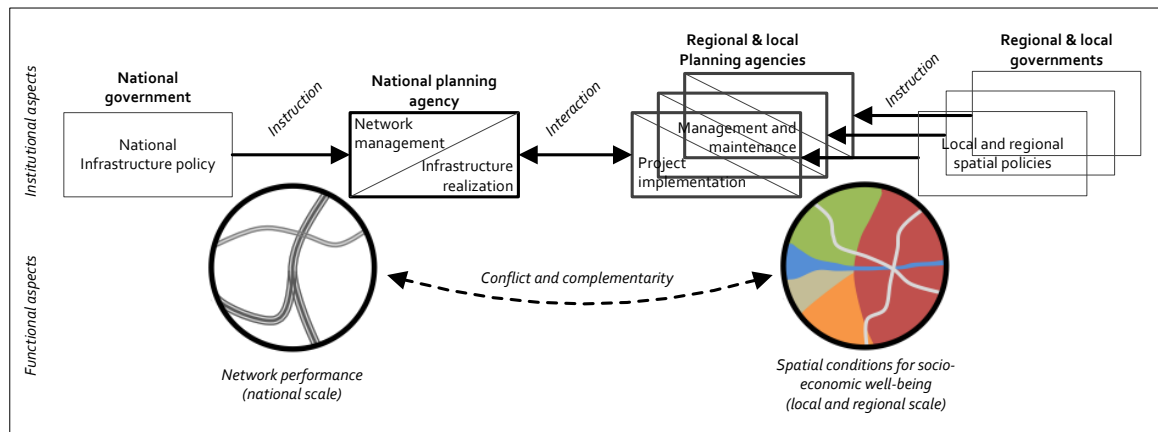


Figure 2. The fragmented infrastructure-land use interface

The effect of institutional fragmentation is complicated by the co-existence of fragmented referential frames. Kaufmann and Smith (1999) describe frames as “devices that individuals use to characterize situations, problems or adversaries”. These frames emerge from different perceptions of what planning is about. These frames may contrast strongly. The technical frame sees infrastructure primarily as part of a high-scale transport network and is strongly focused on the implementation of transport solutions. In contrast, within a relational frame, infrastructures are seen as part of a local area and pursues a broader, collective problem definition.

Due to this institutional fragmentation, the application of area-oriented strategies to deal with the above outlined challenges is a complicated affair. In order to achieve their goals and to improve their interests, the stakeholders at the infrastructure-land use interface need to cooperate. And when interrelatedness increases, the need to cooperate also becomes stronger. Therefore, in the contemporary context of Dutch highway planning, public-public cooperation between different layers of government has become an essential precondition for addressing transport issues.

2.4 The added value of area-oriented highway planning

Line- and area-oriented planning differ with respect to the positive and negative effects of infrastructure planning that are addressed. The main purpose of conventional, line-oriented planning approaches is controlling, constraining and mitigating the negative effects of infrastructure planning. Within line-oriented approaches the positive effects are often encountered at the regional or national scale. It is the performance of the comprehensive transport system and the general economy that benefits most from

investments in major infrastructure. On the local scale, a positive effect may be the enhancement of accessibility, when the location's connection to the transport system or the traffic flow on the transport system are improved. The negative effects of infrastructure planning (e.g. noise, nuisance barriers effects), on the contrary, are strongly felt at this scale. Therefore, a conflict between the infrastructure interest (a national interest) and the local spatial interest is inherent to line-oriented planning (table 1).

Area-oriented planning approaches intend to overcome this scale issue by enhancing the balance between spatial scales. For that purpose, explicit attention is paid to development of local area quality, in addition to protection against negative effects (table 1). For that purpose, area-oriented approaches explicitly explore the complementarity of infrastructures and local land uses. By re-establishing a balance between national, regional and local interests, these approaches provide infrastructure planning with improved means to remain within acceptable limits of time, social costs, stakeholder satisfaction and quality.

Table 1: The positive and negative effects of line-oriented and area-oriented planning approaches at two spatial scales (main difference between line- and area-oriented approaches is in bold).

Infrastructure planning approaches	Positive effects	Negative effects
Line-oriented	National/regional: improved performance of transport and economy	National/regional: investment
	Local: accessibility improvements	Local: environmental effects, barrier effect
Area-oriented	National/regional: improved performance of transport and economy	National/regional: investment
	Local: area quality (cleaner, safer, more attractive environments) and accessibility improvements	Local: environmental effects, barrier effect

The pursuit of a balance between scales through development of local area quality must be seen as the added value of area-oriented planning.

3. Research findings

The findings of the study are presented in two parts:

1. the choice for area-oriented: under what circumstances is integration needed? And, what kind of area-oriented planning is purposeful?
2. the operationalization of area-oriented strategies: how to set up an area-oriented planning approach in order to maximize the added value of integrated planning?

3.1 Choosing for an area-oriented planning approach

The study finds that *the* area-oriented planning approach does not exist. Rather, area-oriented planning must be seen as a form of integration between infrastructure planning and other land uses along two axis: a functional-spatial axis and an interactive axis. Line-

and area-oriented planning can be considered as extreme types at the ends of a continuum of integrated planning approach.

What type of integration is appropriate depends on the interdependence between actors. This interdependence can be related to internal and external factors. Internal factors concern the relations between the highway and other elements within the transport system (such as: the lower network level and / or other transport modalities; and therefore the interdependence with other infraproviders or policy makers). External interdependence concerns the relations with other land uses in the area (housing, nature, water, recreation, business facilities and therefore the interdependence with other stakeholders that are concerned with the development of such land uses (e.g. provinces, municipalities)). Highway planning issues that experience a high degree of internal and/or external interdependence have a stronger need for the application of area-oriented strategies.



Figure 3. The need for an area-oriented approach is determined by the internal and external interdependence of the goal of infrastructure planning and other land use interests for a specific issue.

After the choice for an area-oriented approach has been made, a remaining question is to determine the scope and depths of integration. This involves considerations about the functional scope, the geographical scope and the institutional scope of planning. The *functional scope* relates to the previous (internal/external): is it the project about sectoral infra development or about a combination of infra and e.g. housing and business estate development. The *geographical scope* relates to the spatial scale: a local improvement project (e.g. a new exit) or a project that is mainly relevant to the daily urban system – level (e.g. the A2 Maastricht tunnel) or a project that relates mainly to the (inter)national scale (e.g. HSL). The *institutional scope* relates to the nature of coordination: just coordination or more intensive co-production.

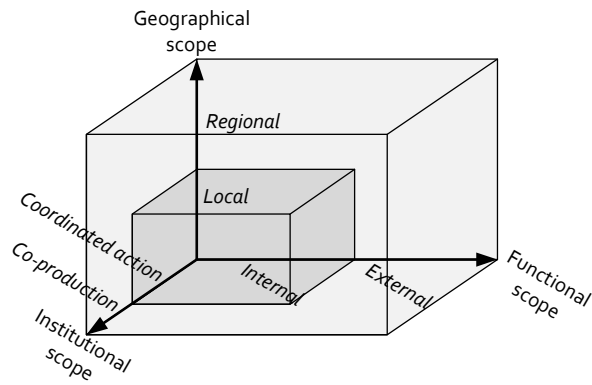


Figure 4. The scope of area-oriented planning may be demarcated along three axes: the geographical scope, the functional scope and the institutional scope

3.2 Creating, assessing and exploiting added value

Section 2.4 already discussed that area-oriented plans may have added value over line-oriented initiatives. We found that addressing functional interrelatedness within a fragmented stakeholder context involves an iterative process creating, assessing and exploiting added value. Six steps are found to be central to the iterations in area-oriented infrastructure planning processes:

1. Assessing the need and scope of integration;
2. Establishing a coalition;
3. Creation: co-producing win-win situations;
4. Assessing the plan or design: comparison and decision support;
5. Exploiting value in decision-making;
6. Follow up: maintaining integration and monitoring.

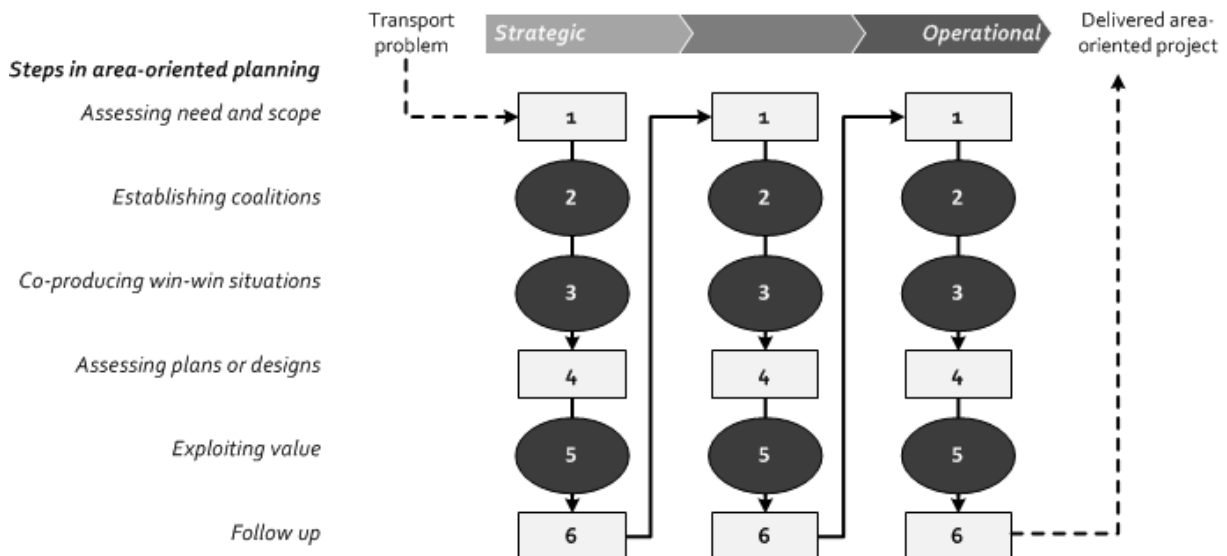


Figure 5. Area-oriented planning as an iterative process consisting of six steps

This process iterates in rounds from strategic to operational planning (see also Teisman, 2000). Likewise, the purpose and scope of each of the process' iterations are different.

4. 8 lessons for planning practice

Section 2.2 outlined a six step process for the application of area-oriented strategies for road infrastructure planning. This section provides recommendations for planning practice to operationalize these steps (table 2). The remainder of this section further explains these recommendations ar.

Table 2. Recommendations for operationalization of the six step area-oriented planning process.

Recommendations relating to assessing the need and scope of integration

- 1 Proactive use of assessment instruments

Recommendations relating to establishing a coalition

- 2 Secure commitment to the integrated planning process
- 3 Create room and opportunities for learning, but also for negotiation

Recommendations relating to co-producing win-win situations

- 4 Be adaptive by combining internal and external integration
- 5 Facilitate a proper substantial discussion

Recommendations relating to assessing the plan or design

- 6 Determine the added value of area-oriented solutions

Recommendations relating to exploiting value in decision-making

- 7 Set up collective business cases to redress the balance between spatial scales

Recommendations relating to follow up: maintaining integration and monitoring

- 8 Organize a grounded dynamic approach of the area-oriented process
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Recommendation 1: Proactive use of assessment instruments

In current planning practice, the starting point of area-oriented planning is often a planning crisis that results in delays or problems with budget, quality and stakeholder satisfaction. It is then realised that the original sectoral approach is not sufficiently equipped for addressing tensions between functional interrelatedness and institutional fragmentation. To prevent such problems early on, an assessment of functional interrelatedness and institutional interdependence could be employed at the beginning of planning processes. It is recommendable to proactively employ instruments for planning and decision-support to determine the need for an area-oriented planning approach and to demarcate an appropriate scope for integration (i.e. functional, geographical and interactive scope – see Figure 4). The application of such assessment instruments is concerned with two questions: (1) whether integration is necessary at this particular stage (i.e. do the co-benefits of integration outweigh the co-costs that such strategies involve), and (2) what kind of integration is desirable? Proactive use of planning instruments may serve as a platform for starting up stakeholder discussions about these topics. Similarly, these instruments may also be used to provide directions for the demarcation of the scope of integrated strategies: what land uses are to be involved in the integrative plan-making? An example of such an instrument is the Sustainability Check ('Omgevingswijzer') – see Heeres et al 2015, Sjaauw en Wa & Arts (2016).

Recommendation 2: Secure commitment of stakeholders to the integrated process

After the need for an area-oriented planning approach has been determined, the next step is to build a coalition and to secure the commitment of stakeholders to a co-

productive process. To exploit the complementarities of technical and relational frames it is essential that relevant actors commit themselves and their organisations to the area-oriented process and its goals, instead of to their own (sectoral) objectives. This study has illustrated a number of means to achieve such commitment.

1. A collective public initiative that functions as an instruction to the actors in area-oriented planning coalitions (see Fig. 7). Instead of a single dominant actor (e.g. Rijkswaterstaat) a joint public-public initiative of e.g. State, Province and Municipality on basis of e.g. a covenant between these parties – as has been the case for the A2 Maastricht case.
2. An outlook at creating potential added value (extra benefits) and the possibilities to regain this value provides an incentive to join an area-oriented planning process.
3. Setting up a system of 'area shares' (Van Rooy, 2011). Stakeholders become shareholders. This gives them a strong, financial incentive to participate in planning coalitions for improving the quality of an area by means of area-oriented approaches. Examples are the development of highways in the USA, which have a business model based on toll revenues and the development of adjacent business locations, hotels, restaurants and gas stations.

Recommendation 3: Create room and opportunities for learning, but also for negotiation

The main challenge for planning coalitions is to bring together technical and relational frames in efficient and meaningful ways in order to exploit their complementarity. This study illustrates that coming to relevant combinations requires *learning* about mutual interests. Such learning can be facilitated by e.g. design approaches or the collective use of hybrid assessment instruments (instruments that address both process and content (see also Runhaar et al., 2009).

However, learning takes place next to negotiation, a second element in the interactive processes of creating win-win situations – see also Woltjer (2000). Negotiation is an important capacity since, in the end, a win-win situation implies that all participating actors have improved their interest positions. Negotiation, however, requires a level planning arena in which all stakeholders have balanced positions in the discussion to avoid advantages of strong procedural frameworks, large budgets etc.

Recommendation 4: Be adaptive by combining internal and external integration

A challenge regarding the co-production of win-win situations concerns the balance between internal and external integration. The choice between external and internal integration is a fundamental trade-off in addressing transport problems. External integration may facilitate the process of addressing transport problems by making enhancements to the transport network. From a transport perspective, choosing for external integration may be essentially motivated to enable the original perceived need for accommodating the growth of car traffic. The funds invested in externally integrated solutions, cannot be used for other potential mobility solutions. Moreover, external integration often results in raising or lowering the road to provide opportunities for local area improvement. These measures are costly and inflexible. A too strong focus on external integration may paradoxically lead to less sustainable outcomes, fresh problems with cost, time and stakeholder satisfaction or even lock-in situations with regard to

innovations in the mobility system (Cantarelli et al., 2010; Priemus & Van Wee, 2013). Internal integration pursues to different measures: measures that pursue multi-modal changes in the mobility system and in the use of transport infrastructure at the level of a daily urban system, rather than the accommodation of the current car-based mobility system.

In order to create the adaptive capacity to be flexible enough to respond to future developments in the region and to move along with a potential mobility transition, the challenge of area-oriented planning is to carefully synchronize internal and external measures (Verweij, 2012). This implies taking into account a multiplicity of land uses and transport provisions at multiple spatial levels. An example of such a smart combination of internal and external measures can now be found in the Eindhoven region (see also Heeres et al 2016). After the failure to complete the regional ring road, the regional coalition of actors directed its attention to transport internal solutions. A bid book containing smart transport solutions has been presented as an alternative solution to address the region's accessibility issues (Noord-Brabant & Limburg, 2015). Another example is the expansion of the Utrecht Ring Road (A27 and A12). As part of the VERDER-programme the project is one of the pillars of a regional mobility strategy: a carefully drafted programme that also contains investments in public transport and mobility management (RWS, 2016).

Recommendation 5: Facilitate a proper substantial discussion

In order to achieve co-production of area-oriented visions, plans and projects there is also need for substantial dialogues about land-use interests: a strong focus on the content of planning. This relates to a joint discussion of actors with contrasting technical and relational referential frames. Despite the contrasts, the technical expertise and sense of purpose of the technical frame and the context consciousness of the relational frame are also complementary capacities in dealing with functional interrelatedness of infrastructure and other land uses. Substantial dialogues therefore need to be stimulated from an early stage onwards.

A case study of the planning process of the Utrecht Ring Road and the Room for the River-project at Nijmegen has highlighted several ways to facilitate these dialogues:

1. A combined design approach with a focus on depiction and calculation. Within an institutionally fragmented context, visualization in drawings is found to be an effective way of learning about multiple referential frames and the interrelatedness of interests. However, infrastructure knows inflexible preconditions, for example regarding traffic flows and capacities of roads or water, the strength of constructions, or safety issues. In order to pay sufficient attention to such preconditions and to avoid disappointment and delay in later stages. Depiction must therefore be accompanied by calculation.
2. This study has shown that the use of broad scopes and easily applicable instruments for planning and decision support may also enhance discussions about the content of plans and designs.
3. In the case studies the employment of an experienced integrated designer proved to be valuable to secure the involvement of both frames. The purpose of this mediator is dual. First, since the differing frames will not automatically meet each other, the mediator has a more conventional role in creating opportunities for

learning about frames and interests. Secondly, however, within an area-oriented planning approach especially proper substantial conversations are important. For that purpose, an additional role of the mediator is also to complement the interactive process with creative ideas and visions about the integration of land uses in an area.

Recommendation 6: Determine the added value of area-oriented solutions

Due to the fragmented institutional landscape that characterizes the infrastructure-land use interface, decision-making is a collective effort of multiple actors. In order to make well-informed decisions about area-oriented plans, the merit of an integrated planning approach must be made clear to decision-makers. Area-oriented planning strategies bring two kinds of added value. First, it improves the specific position of individual spatial interests (i.e. infrastructure, housing etc.). Secondly, it also improves the overall quality of an area ('spatial quality'). To clearly communicate the financial and societal merit of area-oriented alternatives, instruments for planning and decision-support must be applied reactively as well (in addition to the proactive assessment at the beginning of area-oriented planning's iterative planning cycle, recommendation 1). In order to provide decision-makers with as clear and detailed as possible information about the synergy effects of an area-oriented approach, the focus of this reactive assessment effort should be on conventional, more quantitative assessment – e.g. tools like CBA or EIA. The application of assessment instruments should then aim to cover a scope of land-use interests as wide as possible.

Recommendation 7: Set up collective business cases to redress the balance between spatial scales

Another reason to make the synergies of area-oriented plans as clear as possible is to exploit the created value. Decision-making is the moment to exploit the synergies between land uses and to reinstate the balance between geographical scales – i.e. local spatial quality and overall network quality. This study has illustrated that a collective business case may be a means to enhance this balance. This involves the application of value capturing. The main idea behind value capturing is that investments in infrastructure works improve the accessibility of a location, which in turn has a positive effect on property and land value in that area (see also Buitelaar et al., 2010). Value capture mechanisms provide the opportunity to regain these (unearned) benefits and exploit them for either decreasing the infrastructural investments or for the purpose of regional and local area improvements. The first option suits the mono-sectoral focus on the network scale of a line-oriented approach, while the latter option fits within an area-oriented perspective (Hijdra et al., 2015).

In order to apply value capture-mechanisms for reinstating the balance between geographical scales (local and network scale), the added value must be secured in a collective business case. An additional subsequent effect of such collective business cases is that it enhances the cooperation between actors. This has been observed in the A59 Corridor Development. In this project the local business community has asked for ways to contribute to the regional investments in the highway and surrounding areas. They consider this area-oriented investment essential for the continuation of their business in the area.

Recommendation 8: Organize a adaptive approach of the area-oriented process

This study shows that the interrelatedness of land uses is not stable but may change throughout the planning process due to organizational changes, changes in the level of scale and planning tasks that change from strategic to operational. Follow up of integration in consecutive planning roads is therefore essential (see also Teisman, 2000). For that purpose, an effective area-oriented planning process must first of all be adaptive. The focus of integration develops in accordance with the kind of interrelatedness that is encountered in the strategic or operational planning issues of specific planning stages (chapter 3, see also Zonneveld et al., 2009). Additionally, an evolution from strategically to operationally driven integration is advisable. On the one hand, this study illustrates that it can be dangerous to remain strongly dependent on a strategic vision in the later planning stages that ask for more operational considerations. On the other hand, skipping to operational considerations (i.e. integrated design for implementation) too soon may give a project a quick start, but may lead to problems in later planning stages or after completion by resulting less sustainable outcomes.

This study encountered several examples of successful and less successful adaptation. The Utrecht Ring Road has clearly developed its focus from strategic to operational planning issues. The Eindhoven Ring Road stuck to its strategic focus, which caused renewed operational planning issues. The A2 Maastricht had a strong operational focus from the beginning, which may have resulted in missed opportunities for strategic development at the level of the daily urban system.

This study encountered several mechanisms for facilitating and maintaining integration throughout the process. Examples are integrated contracts between public and private parties, an agreement or collective public initiative about cooperation and exploitation between various layers of government and continued attention to public participation.

5. Concluding remarks

This study finds that area-oriented infrastructure planning requires attention to external integration with other land-uses, as well as internal integration with infrastructure networks at other levels and other modalities. A one sided focus on external integration may not fully address the issues related to interrelatedness between land uses at the infrastructure-land use interface. Additional attention to network (management) or multi-modal approaches (both related to internal integration) is needed. Such attention may not only enhance robustness of the transport system at both local, regional (i.e. daily urban system) and national level, but may also enhance the socio-economic development potential (robustness) at local and city-regional level.

Concerning the quote of the director-general of Rijkswaterstaat at the beginning of this paper, for carefully balancing national highway development and local spatial quality both attention for the internal integration of infra and transport as well as external integration with other land-uses seem to be important.

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