

University of Groningen

Towards area-oriented approaches in infrastructure planning

Heeres, Niels

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version

Publisher's PDF, also known as Version of record

Publication date:

2017

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Heeres, N. (2017). *Towards area-oriented approaches in infrastructure planning: Development of national highway networks in a local spatial context*. [Thesis fully internal (DIV), University of Groningen]. Rijksuniversiteit Groningen.

Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license. More information can be found on the University of Groningen website: <https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment>.

Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

English summary

This study is about the interface between highways that are part of large-scale networks and land uses with a local or regional character, such as housing, business, nature, or recreation. Within the context of contemporary planning, the challenges at this interface ask for a new perspective on infrastructure planning.

Challenges at the infrastructure-land use interface

Highway infrastructure is 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, highways define the spatial structure and layout of areas. 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.

This interrelatedness is functional as well as spatial. Functional, since highways and other land uses actually influence each other's quality. One may think of the interchange of traffic between highways and local infrastructure. Or the barrier effect that highways have as they cut through the original spatial structures of areas (e.g. nature, landscape or settlements). Spatial, since the land uses often are physically close to each other or, even, claim the same space. Noise barriers that separate the highway from the houses in the same area can be seen as a manifestation of this conflicting physical adjacency.

In the current context of planning in western societies, the interrelatedness between highways and the surrounding environment has become so strong that, over time, conflicts often may lead to loose-loose situations or lock-ins (i.e. continuation of an existing situation, rather than adapting to new circumstances). Many examples of cost and time overruns, low stakeholder satisfaction and low quality, related to conflicts between highways and surrounding areas, can be found in infrastructure planning of the past decades.

This means that infrastructure planning and planning for other land uses are interdependent. Consequently, policy makers and planners need to cooperate with others to operationalize integrated strategies (i.e. co-production) for achieving their own particular goals. The consequence for infrastructure planning is that, when the interrelatedness of land uses is particularly strong, it becomes partly dependent on other stakeholders for supporting, permitting or financing developments, or just because of other stakeholders' capacity to slow down or to stop the planning process. Due to the dependency for realizing infrastructure plans and projects, cooperation with other actors with a spatial stake in the area has become a necessary precondition in infrastructure planning.

Goal of the study

In order to enable 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, the application of area-oriented approaches in highway planning has been studied. The main objective of this study has been:

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 objective contains two important elements. First of all, this study aims to improve the understanding of whether and why area-oriented approaches may be applied. For that purpose, chapters 2 and 3 of the study look at the conditions under which area-oriented planning approaches can be effective and efficient alternatives to conventional infrastructure planning strategies. Secondly, to appropriately formulate directions for the design of an area-oriented approach, chapters 4, 5 and 6 pursue to identify critical factors and possible optimizations for creating, assessment and exploitation of added value at the infrastructure-land use interface.

The study has taken a qualitative case study approach. Nine infrastructure planning projects from the Netherlands have been studied in depth. Dutch infrastructure planning is an interesting case for learning about the application of area-oriented strategies. Due to the interrelatedness between the various land use interests that infrastructure planning encounters in the Netherlands, much experimentation with integration is going on. At the same time, from an institutional perspective, planning for major infrastructures and other land uses are strongly fragmented. Therefore, co-production of plans at the infrastructure-land use interface is challenging, despite the Dutch consensus-oriented tradition.

The realization that an adjusted planning approach is needed for addressing planning challenges at interface of infrastructure networks and local and regional land uses is broader than just the Netherlands. For instance, in the USA and the UK an interest in establishing partnerships and broader governance strategies can be observed. Therefore, application of the findings of this study is not restricted to the Netherlands.

The need for a changing perspective

Strong functional and spatial interrelatedness and the interdependence of stakeholders changes the balance between land uses in highway projects. This context requires an adjusted planning perspective. To deal with these issues, highway planning in many modern Western countries seems to have acknowledged the need for integrated planning approaches. This happens also in the Netherlands, where integrated planning approaches have received much attention. The Netherlands is a small but densely populated country, which causes a strong interrelatedness between the various land use interests. The impact of major infrastructures on the environment is a much-debated theme in Dutch infrastructure planning. Political and societal dynamics further increase the complexity of

highway projects in the Netherlands. Examples of the integration of infrastructure and other land uses can be recognized throughout Dutch highway planning.

Integrated plan-making aims to enhance the effectiveness of planning by enhancing the coordination between various sectoral spatial policies. Integrated infrastructure planning can be understood as a planning strategy that aims to improve the interests other stakeholders at the interface of infrastructure and other land uses in an area. These integrated approaches contrast the inward focus of the conventional sectoral approach in infrastructure planning. Sectoral planning approaches the development of main highways primarily as an isolated engineering challenge, driven by a strong technical rationality. For that purpose, the highway planning sector – in the Netherlands but also in many other countries – developed into a separate spatial silo, with its own policy frameworks, legislation, organizations, and budgets. This sectoral approach seems to be difficult to reconcile with the high functional interrelatedness and fragmentation of relevant actors, as may be concluded from the many cost and time overruns and support issues for highway planning proposals.

The transformation from sectoral to more integrated planning at the infrastructure-land use interface has started as a slow “policy revolution” in the Netherlands, which is currently still going on. Among others, some relevant policy developments in the light of this study are: the merger of the national operational programmes for road infrastructure and other spatial ambitions in 2007; the merger of the ministry for responsible for infrastructure and transport and the ministry responsible for spatial planning into the Ministry of Infrastructure and the Environment in 2010; and in 2012 the merger of the strategic policy ambitions for road infrastructure and spatial planning into one comprehensive national plan. Furthermore, in the (near) future, the various procedural frameworks will be restructured thoroughly, with the introduction of integrated legislation to efficiently support a comprehensive view on (spatial and infrastructure) planning. In infrastructure planning practice, the described policy transformation is reflected in an interest in so-called ‘area-oriented’ strategies. Similar policies can be found in other countries. Examples are the introduction of ‘context-sensitive’ and ‘place-based’ in the USA and the UK.

The expectation is that earlier and stronger integration of land uses improves the quality of plans and designs. However, quality is a concept that is difficult to define. In planning, quality is usually defined in political choices or policy instructions, which guide the actions of planning organizations. Therefore, perceptions of quality are often different for every organization. The actions that actors employ essentially serve to improve the performance of these interests. Quality improvement could therefore be seen as something that is valuable to these actors: it represents a certain value to them in the achievement of their interests. The extra qualities in the outcomes of integrated planning processes, which can be attributed to co-evolution of various land use interests, may be understood as the added value of integrated planning over sectoral planning. Therefore, the creation, assessment, and exploitation of this added value are central themes in the integrated planning debate. Hence, these concepts are one of the primary concerns of this study.

A challenging institutional context

Consequently, to the emergence of separate policy silos, policy making, as well as the actual planning and realization are carried out by specific institutions. In the Netherlands, for example, infrastructure policy has long been prepared by a specific ministry, in targeted policy documents. This policy is carried out by dedicated planning organization responsible for highways, such as Rijkswaterstaat in the Netherlands (the executive agency of the Ministry of Infrastructure and the Environment). The main task of these organizations is the performance of the highway networks at the national scale. At the regional and local level, policy making and planning for land uses is done by provinces and municipalities. Like the national level, these governmental layers instruct their own organizations for project implementation and for management and maintenance of their land use interests.

This institutional fragmentation is further complicated by the co-existence of different referential frames. Frames may be understood as perceptions that groups or organizations use to interpret problems and to provide directions for solutions. These frames may contrast strongly. In a more technical frame infrastructure is primarily seen as part of a high-scale transport network and focus is primarily on the implementation of transport solutions. In contrast, within a relational frame, infrastructures are seen as part of a local area and focus is on a broader, integrated 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.

Findings

Chapter 2 explores the shift from line-oriented planning towards area-oriented planning. From an historical analysis of policy documents, three central parameters for conceptualizing area-oriented approaches become apparent:

- The level of integration between infrastructures and other land use interests;
- The geographical scope of planning;
- The involvement of various actors in the planning process.

First, concerning the level of integration, a distinction is made between internal and external integration. Internal integration is the convergence of policy-making and planning for several components within the traffic and transport sector; external integration can be understood as the enhanced coordination between road infrastructure and other land use functions. Second, the geographical scope may reach from a narrow focus on the area directly surrounding the road to a focus on the wider region. Third, the involvement of actors could range from merely the responsible infrastructure planning agency to the involvement of local and regional government in planning and decision-making.

On the basis of these parameters, two infrastructure planning approaches can be distinguished: 'line-oriented' and 'area-oriented' planning approaches. These strategies must be seen as the extremes of a spectrum of strategies for addressing issues at the interface of major infrastructures and other land uses. This spectrum contains other, in-between types, such as routing, network-approaches and context-sensitive design.

Conventionally, highway planning has a strong inward focus. Infrastructure realization for transport goals is the main interest of this 'line-oriented-approach'. Characteristic for these approaches is that the functional and geographical scope of planning are kept as narrow as possible. The efforts regarding other land uses, besides the infrastructure, are limited to mitigating and compensating for negative environmental effects. The purpose of this approach is to ensure a goal-oriented planning process that leads to smooth and cost-effective implementation of (infrastructural) solutions to transport issues.

Within 'area-oriented approaches' land uses at the local or regional scale are considered as important and influential as the infrastructural interest. This different perspective 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 land uses (such as housing, business and recreation) and with land uses with a more regional character (for example regional economic development, agriculture and nature). This adjusted objective must be seen as an expansion of the line-oriented perspective: area-oriented planning's pursuit of win-win situations stands next to protection against adverse environmental effects. In addition to protection against negative effects, explicit attention is paid to enhancement of local area quality. Next to area-oriented planning, a second form of integration can be distinguished: area development. Area development is concerned with one fully integrated programme of aims for an area, rather than a transportation project with a broadened objective. Within area developments, transportation is one of the challenges, equal to other spatial challenges in the area. Together with these other issues, improvements to the area's transportation system determine the success of area developments.

While chapter 2 contrasts line- and area-oriented strategies, *chapter 3* takes an in-depth focus on the use of area-oriented strategies in infrastructure planning. The chapter conceptualizes and analyses why and how such integrated approaches can be applied effectively throughout consecutive stages of infrastructure planning. For that purpose, the chapter distinguishes between abstract explorations of potential solutions and more detailed studies on the implementation of chosen solutions. The two case studies illustrate that the concept of integration is applied for strategic as well as operational reasons. Moreover, the case studies reveal that these reasons may alternate throughout the planning process. Effective integration is therefore adaptive: it appropriately focuses on strengthening the socioeconomic perspectives of a wider region for the longer term, as well as on the relations between different land uses that are physically adjacent and competing for space within a smaller area.

Due to fragmented institutional contexts, successfully dealing with interrelatedness requires an intense level of interaction amongst actors involved. Such co-production of

visions and plans has two important characteristics: learning about each other's goals, and negotiation about interests. The case studies show that the character of consensus-seeking is different for strategic and for operational integration. Within strategic integration, the emphasis of co-production is primarily on learning about mutual interests and the interrelatedness of interests. Within integration for operational reasons, co-production places more emphasis on negotiations about a specific area's physical urban or landscape design.

Ultimately the case studies in chapter 3 show that planning at the infrastructure-land use interface needs institutional mechanisms to guide the alterations between strategically and operationally inspired integration. Examples of the institutional mechanisms encountered in this study are, for instance: covenants about cooperation between public authorities; integrated contracts with private parties; early and sustained public participation; and, conditions that stimulate learning about each other's referential frames.

From *chapter 4* onwards this study focuses on directions for area-oriented planning strategies. The main theme of chapter 4 is the creation of added value at the infrastructure-land use interface. The point of departure of this chapter is the realization that effective operationalization of co-production remains difficult due to the strong fragmentation at this interface. Various policies introduce integrated spatial design efforts to the infrastructure planning processes as a strategy to deal with this issue. The chapter explores experiences in the Netherlands that have placed spatial design in key positions in the process.

An exploration of literature from the fields of spatial design, planning and geography focuses on the content of design (what is being designed) as well as the design process (how designing takes place and by whom). Four types of design are distinguished, from which the contrast between 'technical design' and 'relational design' is the most interesting for the debate about area-oriented planning. While technical design is primarily concerned with the functioning and the aesthetics of the infrastructure itself, the main purpose of relational design is to place the infrastructure within the wider network of land use relations of the area surrounding the infrastructure. Based on the literature, it is suggested that a relational design approach may be applied to stimulate a communicative modus that fosters dialogue, creativity and eventually an inclusive and shared story about an area's future.

In order to verify this concept, designers experienced in serving that role have been interviewed about whether and how co-production takes place. Consecutively, in order to come to practical lessons for exploitation of the merits indicated by the literature analysis and the interviewees, two projects that the interviewees considered best practices have been studied. An important finding is that the strengths and weaknesses of technical and relational design approaches complement each other. A combination of technical and relational design can effectively help a fragmented group of actors to find a shared and meaningful story and make integral choices on infrastructure projects, framed within a wider area's development. Ensuring effective use of technical and relational design requires a coordinating role for a broadly oriented designer, but also the right mind-set

among participants. This way, the employment of such design approaches facilitates effective operationalization of collaborative governance at the infrastructure-land use interface.

Chapter 4 also highlights several preconditions for the application of integrated design approaches. A first precondition concerns the role of spatial designers to coordinate the design process. This role demands that designers have vast substantial knowledge, understanding of sectoral and technical detail, a sense for the interrelatedness of land uses, political sensibility, and an interactive view on planning. This combination of content and process related capacities may be expected to be more effective than the involvement of the omniscient designer or a general mediator. Another precondition is the need for a shared sense of urgency. Such a sense may emerge, for example, after a crisis in preceding planning phases or through a collective public initiative.

Chapter 5 focuses on the assessment of added value. The aim of this chapter is to draw lessons about recent innovations in decision support for coping with challenges in integrated infrastructure planning strategies. After setting up a conceptual framework about the scope of analysis and the role of information in infrastructure planning, the empirical section of this chapter explores the introduction of early-stage sustainability assessment tools.

Empirical data collection has drawn on experiences gained in the Netherlands with a tool called the 'Sustainability Check' (Omgevingswijzer) and this has been complemented by document analysis and interviews with experts in the field. On the collection and communication of spatial intelligence, on the generation of alternatives, and the choice for one preferred alternative, such instruments are essentially different from conventional instruments – such as cost-benefit analysis (CBA), environmental impact assessment (EIA). The case studies illustrate how the Sustainability Check distinguishes itself from conventional instruments through a more inclusive scope and equal treatment of primary and ancillary effects. Regarding the planning process, proactive application, a transparent process, lower assessment costs and strong communicative capacities make the instrument well equipped for coping with institutional fragmentation.

Chapter 5 concludes that instruments such as Sustainability Check have a number of potentially useful capacities. Due to these capacities, the use of this type of instruments supports the integration between highway and surrounding areas as it addresses the challenges of area-oriented planning:

- Usefully bringing together information about the comprehensive value of alternatives;
- Facilitating the generation of alternatives by proactive use of the information;
- Addressing institutional fragmentation by learning about referential frames;
- Placing the 'hard' outcomes of conventional tools within a contextual perspective.

Despite these capacities, these early sustainability assessment tools should not be seen as a replacement for conventional decision support tools, but rather as complementary tools in addressing challenges posed by area-oriented infrastructure planning.

The main theme of *chapter 6* is the exploitation of value. From a value capture perspective, integration offers possibilities for financially linking road infrastructure and other land uses. Additionally, value capturing may be expected to have value for the cooperation between involved, but often institutionally fragmented actors. This chapter explores the relations between the application of different types of value capturing and cooperation between fragmented actors in planning at the infrastructure-land use interface. Three different value capture types are compared in chapter 6: (1) compulsory capture, (2) negotiated capture, and (3) voluntary capture. These types differ with regard to the kind of coordination mechanism that is applied, as well as to the grounds for value capturing.

For the analysis, three area-oriented infrastructure projects have been explored. First, the case studies confirm the financial value of value capturing. Value capturing makes it possible to recycle the unearned value increments that emerge from the combined improvements to accessibility and area quality in integrated planning processes at the infrastructure-land use interface. In the case studies, the synergies between accessibility and area quality led to higher private land and property values, which were partly captured by the application of value capture mechanisms. Second, the study finds that the application of value capture-mechanisms could indeed enhance cooperation among fragmented actors in the planning processes that take place after capture. Capturing unearned value through the application of value capture mechanisms explicates the added value; it then becomes attractive for actors to proactively participate in integrated coalitions.

A positive influence on the co-production of plans and projects is observed in those cases where capturing value is based on partnership (i.e. negotiated or voluntary capture). It appears that, in the stages that precede the actual value capture, parameters such as awareness of interdependence, understanding of mutual interests, and human efforts may establish the required preconditions for viable application of value capture mechanisms. In later stages, when values are captured and redistributed, an established shared business case and official agreements may help to maintain conditions for cooperation, by explicating and institutionalizing the interdependency of the involved organizations.

Directions for planning practice

This study confirms the potential merit of area-oriented planning strategies over line-oriented planning under conditions of strong interrelatedness and high institutional fragmentation. It is also found that addressing functional interrelatedness between infrastructure and other land uses within a fragmented stakeholder context involves a careful process of creating, assessing and exploiting added value. Furthermore, the cases studied illustrate that interrelatedness of land uses is not stable, but may evolve from a strategic issue into a more operational issue. For that purpose, an effective area-oriented planning process is first and foremost an adaptive process. The focus of integration should evolve in accordance with the kind of strategic or operational interrelatedness that is encountered in specific planning stages. The process of creating, assessing and exploiting added value therefore iterates from strategic to operational planning. Six steps are found to be central to the iterations in area-oriented infrastructure planning processes.

1. Assessing the need and scope of integration

To determine whether and to what extent an area-oriented approach is needed and may lead to added value, an assessment of the interrelatedness of land uses is necessary at the beginning of every stage of a planning process. Assessment instruments may be used proactively to determine the need for integration and to demarcate its scope and depth.

2. Establishing a coalition

In order to utilize the potential merit of area-oriented planning and an expanded scope, it is advisable to organize integrated processes as a co-production. The organization of such processes under circumstances of high functional interrelatedness and strong institutional fragmentation requires the formation and formalization of coalitions. The establishment of coalitions may be formalized in covenants or other types of agreements about cooperation between various actors at the infrastructure-land use interface.

3. Creation: co-producing win-win situations

The purpose of co-production of area-oriented plans and designs is to find relevant combinations between road infrastructures and other land uses. This involves a balance between learning and negotiation. On the one hand, learning is concerned with exploration of potential synergies at the interfaces of land use interests in an area. Learning processes asks for a proactive focus on exploration and exploitation of the complementarities between land uses, rather than a reactive focus on avoiding potential conflicts between land uses. Negotiation, on the other hand, puts central the optimization of individual stakeholders' interest positions. Therefore, negotiation is an essential key factor in the pursuit of win-win situations – making sure that the plan enhances the quality of sectoral spatial interests in the area.

4. Assessing the plan or design: comparison and decision support

To be able to address functional interrelatedness and to assess the full breadth of integrated plans and designs, assessment ideally combines lighter instruments for qualitative assessment with more detailed instruments for quantitative assessment. In addition to the detailed, but narrow and absolute perspectives provided by conventional instruments (such as CBA or EIA), lighter qualitative instruments prove to be very suitable for sketching 'real world' impacts and giving the decision-makers a sense of a proposed intervention's implications.

5. Exploiting value in decision-making

Decision-making is the moment to exploit the gains from improved accessibility. Exploitation of these gains, for example in a collective business case that pays attention not just to infrastructural improvements, but to interrelated local and regional land uses as well, may produce an attractive outlook at combined improvement of accessibility and area quality. This study illustrates that especially value exploitation through the application of partnership-based value capture mechanisms enhances the co-production of plans and designs.

6. Follow up: maintaining integration and monitoring

Area-oriented planning involves strategic as well as operational considerations about the interrelatedness of highways and other land uses. Therefore, after decision-making,

during subsequent planning stages, it is essential to maintain an appropriate level of integration. In order to deal with this adaptive character, reflection on the need and focus of integration at the new planning stage is required.

Eight lessons

The outlined six-step process for the application of area-oriented infrastructure planning strategies is complemented with eight practical lessons. These lessons serve to operationalize the above-outlined six step process.

1. Proactive use of assessment instruments

To determine whether integration is needed and what scope would be most appropriate instruments may be used at the beginning of new planning stages.

2. Secure commitment to the integrated planning process

To exploit the potential merit of actors' complementarity in the creation of integrated plans, it is essential that the commitment of actors is not without obligation. Commitment and cooperation within coalitions can, for example, be formalized in administrative agreements.

3. Create room and opportunities for learning, but also for negotiation

The creation of win-win situations asks for a combination of learning and negotiation between actors. Learning about mutual interests is a precondition for the co-production of plans and designs; negotiations are needed to stimulate and facilitate actors to act from the improvement of their own interest positions.

4. Be flexible by combining internal and external integration

Many contemporary area-oriented plans emphasize the integration of highways and other land use interests in the directly surrounding area (i.e. external integration). However, future-proof and sustainable solutions require that also the capacity of solutions within the traffic and transport system – internal integration – is taken into account.

5. Facilitate a proper substantial discussion

Despite the contradictions between the technical and the relational frame, both are needed in order to find area-oriented solutions to transport problems. By means of a combined design approach, with room for depiction and calculation, an in-depth problem-oriented discussion, in which the capacities of both frames are combined, may be facilitated.

6. Determine the added value of area-oriented solutions

Well-informed choice, selection and decision-making requires as much insight into the (additional) effects of area-oriented plans and designs. The required insight contains the transport value of proposals, as well as the area value of proposed integrated plans.

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

One of the points of departure of area-oriented highway planning is that not only improvements to the highway network are pursued. Area-oriented planning explicitly focuses on improvements to the land uses at the regional and local area scale in the area.

Business cases that focus on this additional objective may help to redress the balance between gains at the networks and gains at the regional and local spatial scale. For example, value gains that follow from enhanced accessibility may be recouped and used to enhance local area quality.

8. Organize an adaptive approach of the area-oriented process

When planning processes proceed from one planning stage to subsequent stages, for example after choices and decision have been made, the scope, objective and organization of planning of these processes may change. Such changes imply that the interrelatedness of land uses and interdependence of actors are not stable throughout the various phases of planning processes. Area-oriented strategies need to be adaptive to address this issue: a redetermination of need, scope and depth of integration is necessary at the start of every new planning stage.

Towards area-oriented approaches in highway infrastructure planning

This study has found that effective application of area-oriented infrastructure planning involves 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 interrelatedness between land uses at the infrastructure-land use interface. Additional attention to better use of existing transport networks and multi-modal approaches is needed as well. 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. Therefore, enhancing the synergies between highway networks and the spatial quality of areas at the local and regional scale requires an adaptive planning approach that focuses on both internal integration within the infrastructure and transport sector, and external integration with other land-uses.

