Making planning support systems matter : improving the use of planning support systems for integrated land use and transport strategy-making

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Chapter 4

Land Use and Transport PSS: Meaningful Information through a Dialogue between Modellers and Planners

One of the key barriers to integration of land use and transport planning is the lack of a 'common language' (i.e. tools, instruments, indicators) that can support planners from both domains in developing shared visions and integrated strategies. Many of such tools and indicators have been developed in recent years, but not so many are implemented in practice. In this chapter a new, participatory development approach for Planning Support Systems (PSS) is proposed, termed 'Mediated Planning Support' (MPS) that addresses bottlenecks blocking this implementation. It is founded on insights from knowledge management, system dynamics and software innovation and is applied in the Greater Region of Amsterdam. This chapter discusses the evolution of the PSS, highlighting the most useful elements which can be applied in other land use and transport planning projects. It offers insights for practitioners and researchers interested in land use and transport planning integration and for professionals that are dealing with supporting planning with information and technologies.

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4.1 SUPPORTING THE INTEGRATION OF LAND USE AND TRANSPORT PLANNING

A better integration of transport and land use planning is believed to be crucial in achieving more sustainable mobility patterns in urban areas and is advocated by academics (e.g. Banister, 2005; Cervero, 1998; Meyer and Miller, 2001), professionals (e.g. Transportation Research Board, 2004), governments (e.g. European Commission, 2007; European Conference of Ministers of Transport, 2002) and business (e.g. WBCSD, 2001, 2004) alike. Underlying this is the belief that if the land use and transport systems are reciprocally supportive, important benefits of mobility are increased (i.e. improved access to activities and jobs, a higher standard of living (WBCSD, 2004, p. 13)), while negative impacts (i.e. pollution, risk, congestion etc. (see e.g. Banister, 2005; WBCSD, 2001, 2004)) are reduced. Several empirical studies support this belief, by showing strong interactions between both systems (overviews in: Banister, 2005; Hanson and Giuliano, 2004; Meurs, 2002; Meyer and Miller, 2001; Wegener and Fürst, 1999). It also reflects a long-standing body of theory on the relationship between land use and transport (Giuliano, 2004; Manheim, 1974; Meyer and Miller, 2001; Mitchell and Rapkin, 1954; Wegener and Fürst, 1999).

From planning theoretical considerations, such integration can be most fruitful if it occurs in early phases of the planning process (Friedmann, 1987; Healey, 2006). The minds of the planners in both domains are still open in these phases; this is necessary in order to come up with innovative ideas and shared concepts and visions. The issues that are being dealt with here are also less contested due to their abstract nature. It is assumed that with shared land use transport (LUT) visions and concepts in place, the chances of conflicting land use and transport plans and projects are significantly reduced.

Yet, in general, real integrated LUT planning processes are often absent in planning practice, especially in these early phases of planning (Banister, 2005; Stead et al., 2004; Transportation Research Board, 2004). Now both domains develop their own separate visions, scenarios, plans and projects focussing on either specific land use or transport issues. As a result, plans and interventions that are derived from these visions are often (unintended) suboptimal or, in the worst case, conflicting (e.g. car dependent development or unprofitable public transport systems).

A number of factors seem to explain this difficult integration. The cited studies name both institutional/procedural discrepancies (i.e. different planning institutions, financial arrangements, etc.) and substantive differences (i.e. different planning objects, information, knowledge etc.). This is also recognized in recent, dedicated research projects such as DISTILLATE in Great Britain (Hull and Tricker, 2006; Jones and Lucas, 2005) and IMPACT in Sweden (TransportMistra, 2007). Although we recognize that the institutional and substantive domains are strongly interrelated, the focus of this chapter is mainly on the substantive barriers.

There have been significant academic and professional efforts to develop common LUT concepts in recent years with the goal to bridge the substantive differences between the two planning domains. The outcome of this is a host of integral indicators (i.e. potential accessibility measures (see e.g. Bertolini et al., 2005; Geurs and Van Wee, 2004)), tools and instruments (i.e. Land Use Transport Interaction tools such as MARS (Emberger and Ibesich, 2006) and UrbanSim (Waddell, 2002). However, recent studies show that this information and these 'state of the art' instruments are hardly used to support LUT integration in planning practice (NICHES, 2007, and chapter two of this dissertation). Especially in the early phases of planning there is still a deficiency of relevant integral information and tools (see Hull, 2005; Jones and Lucas, 2005; Te Brömmelstroet, 2010). The tools that do find their way into planning practice are in most cases developed to support the analysis of trends, the evaluation of alternatives or the assessment of projects. Not many of them are able to support scenario-building, story-telling or visioning, all specific tasks in early planning phases. This is not unique for land use and transport planning. The so-called 'implementation gap' is shown in many different studies on the (lack of) use of dedicated information and instruments to support (spatial) planning (see Brewer, 1973; Couclelis, 2005; Danziger, 1977; Klosterman, 1997; Klosterman, 2007; Langendorf, 1985; Lee, 1973; Lee, 1994; Stillwell et al., 1999; Uran and Janssen, 2003; Vonk et al., 2005). Note that the gap is not only apparent in a wide range of planning domains, but it is also consistent as a trend over a long period of time.

Generally, two extreme types of reactions on this implementation gap exist (Meadows and Robinsons, 2002). On the hand, notably planners argue that they do not need tools and instruments in strategic phases. Intuition and experience are enough. On the other hand, notably modellers suggest that current models fail to represent much of the complexity of real life and more sophisticated models have to be developed to convince planners to use them. We assert that in strategic phases an understanding of the crucial mechanisms of reality is crucial to develop efficient strategies, as these mechanisms can be counterintuitive. So supportive models are needed to enable the planner to learn and play with interventions, but they can only be used if they offer a better understanding to the planners; without understanding of the (key mechanisms in) the model, the planner can not learn and translate these lessons in more efficient strategies. The central challenge is to find this balance between complexity and understanding (Bertolini et al., 2005).

To address this challenge, we have taken an approach based on insights from several related academic fields and focus on linking the *existing* routines of planners in specific planning contexts and *existing* models in more meaningful ways. Following findings in the academic fields of knowledge management, software development and system dynamics (Checkland, 2001; Checkland and Scholes, 1990; Nonaka, 1994; Nonaka and Konno, 1998; Rouwette et al., 2002; Stapleton and Constable, 1997; van den Belt, 2004) we hypothesize that such an approach can give us more valuable insights in how we can truly support the land use and transport planners in the very specific tasks of early planning phases. Firstly, these are insights in how planners work now, where they see chances of land use transport integration and what characteristics dedicated information has too have to support this. And secondly, these are insights in the different sorts of information and instruments, how they are perceived in specific situations and how they can be linked to the specific knowledge field of both land use and transport planners. A context-specific combination of these two kinds of insights seems crucial in bridging the ‘implementation gap’. The approach that we have used for this is coined ‘Mediated Planning Support’ (MPS). The reference is to the notion of Planning Support System (PSS), defined here as an infrastructure that systematically introduces relevant (spatial) information to a specific process of related planning actions (based on Klosterman, 1997). Our specific approach to its development is through a mediation process with modelers and planners.

The goal of this chapter is (1) to present MPS as an innovative development method to overcome the implementation gap of land use and transport integration tools and (2) to show the results of a first test case in the Netherlands in terms of the specific requirements for information to support integration of land use and transport planning in early phases. These insights are formulated as field-tested hypotheses that will have to be further tested in other cases based on a design oriented research approach (see Pawson and Tilley, 1997; Van Aken, 2004, 2005).

In the following, we will start by defining differences that exist between the sort of knowledge used by land use and transport planners and how these hinder integration. Then, we will shortly discuss how instruments that attempt to bridge these differences are currently used and perceived by planners. Following that, the current debate on the implementation gap of Planning Support Systems is summarized, focussing on proposed directions for improvement. We then make the case that key concepts developed in the practice and literature of knowledge management, system dynamics and software development can serve as useful guidelines for this. We shortly introduce this body of work and modify it to be useful for developing PSS, and thus introduce the MPS approach. The body of the chapter addresses how the MPS method was used in integrated planning processes for the greater Region of Amsterdam. We will synthesize the general insights on the requirements for supporting information and close with conclusions on the developed LUT PSS, a methodological reflection on MPS and recommendations for further research.

4.2 A DEFINITION OF KNOWLEDGE

The substantive barrier between land use and transport planning is related to the differences in types of knowledge used in both domains, fostered by the differences in educational backgrounds and the dominant epistemological frameworks that are used. Before we proceed with the analysis of these differences, it is essential to define how we use the term ‘knowledge’.

The existing literature provides no clear consensus about what precisely constitutes knowledge and how it is distinguished from information (Checkland and Holwell, 1998). This chapter adopts the definition that knowledge is a meaningful collection of information, such that it can be used in a specific context (Ackoff, 1989). For our argument, we will make use of a distinction between “tacit knowledge” and “explicit knowledge”, a concept developed in the field of knowledge management (see Nonaka and Takeuchi, 1995; Polanyi, 1967). Here, explicit knowledge is characterized as easily codified, formalized and expressed in words and numbers. It can be shared in systematic language, maps and indicators (Nonaka, 1994, p. 16). Tacit knowledge on the other hand is deeply rooted in action, meaning and personal experience in a specific context. It is harder to codify and share. Converting existing knowledge into new knowledge (i.e. separated land use and transport knowledge into integrated LUT knowledge) requires interaction between tacit and explicit knowledge in an iterative fashion (as is elaborated in Nonaka and Takeuchi, 1995).

4.3 DIFFERENCES IN LAND USE AND TRANSPORT KNOWLEDGE

Substantive differences between land use and transport planning are not only related to explicit knowledge (e.g. differences in indicators, theories and planning objects); there are also strong differences in tacit knowledge domain. We posit that these differences are 1) one of the primary reasons for the lack of implementation of existing LUT tools and 2) largely ignored in the development of these tools. Below we will shortly introduce these differences. The differences sketched below are somewhat extreme, in the sense that they show archetypes of two planning domains. We realize that practice is less black and white, but see this as a useful characterization.

However increasing attention for communicative approaches (see for example Banister, 2008), scientific instrumental rationality still seems the predominant paradigm in the field of transport planning (Willson, 2001). Therefore, transport planners tend to use more quantitative information concerning e.g. transport flows, levels of service and costs. They focus more on general theories and computer models and tend to have an engineering background (Willson, 2001, p. 2). In general, transport planners focus on solving problems (i.e. congestion) and optimizing the transport system, without much attention for wider (social, economic) goals that can be achieved. In other words, the focus is on finding the means (e.g. congestion charge or highway extension) for a given goal (e.g. efficient functioning of the network). Transport planners often use predictive forecasting methods to deal with uncertainty in the future (Jones and Lucas, 2005; van der Bijl and Witsen, 2000; Wachs, 1985; Zapatha and Hopkins, 2007).

On the other hand, land use planners tend to use more qualitative spatial information about places and functions, work in more communicative settings and often have a background in design or the ‘soft’ social sciences. Today’s predominant land use planning mode is (at least theoretically) based on communicative, deliberative rationality in which multiple stakeholders are included (e.g. Forester, 1999; Healey, 1997; Innes, 1995). The focus lies on confronting and bringing together multiple goals from multiple disciplines in inclusive strategies. They deal with uncertainty in the future in many different ways (planning, scenario’s and visioning) (van der Bijl and Witsen, 2000; Zapatha and Hopkins, 2007).

4.4 THE STATE OF PRACTICE OF CURRENT LUT PLANNING SUPPORT TOOLS

In 2007, an internet based survey was conducted among planning practitioners in the Netherlands that had experience in attempts to integrate land use and transport planning processes (Te Brömmelstroet, 2010). The goal was to explore patterns in the lack of implementation of existing tools and broad directions for possible improvement. Findings showed that the respondents (62 transport oriented, 60 land use and 2 unknown) think that current tools don't provide enough insight in LUT relations, that tools are often used to justify choices that have already been made, that the tools do not fit the planning process and that they are not well linked to the political decision making process. There is not enough support for the generation of alternative solutions and the tools are often implemented too late in the planning process (Te Brömmelstroet, 2010, pp. 12-13).

Four possible bottlenecks behind these problems were seen as (big) problem by more than half of the respondents; (1) the tools are not transparent enough, (2) they are not user friendly, (3) they are not useful in interactive settings and (4) the communication value of the outcomes is too low to be useful in the planning context.

These findings echo those of the broader international debate on decision and planning support tools, where it was found that planners see most of these tools as far too: generic, complex, technology oriented (rather than problem oriented), narrowly focused on strict technical rationality and incompatible with the unpredictable/flexible nature of most planning tasks and information needs (Bishop, 1998; Couclelis, 2005; Geertman, 2006; Klosterman, 2001; Lee, 1973; Lee, 1994; Ottens, 1990; Scholten and Stillwell, 1990; Vonk, 2006). Geertman asserts that the history of planning support tools shows a continuous mismatch between the characteristics of developed tools and characteristics of dominant planning traditions (Geertman, 2006, p. 876). To break through this, Geertman proposes to focus on a better link with the tacit knowledge of the actors in the planning process, with relevant planning issues and with the context-specificities of the planning process, explicitness and transparency in underlying premises, methods and outcomes, and an adaptation of planners (e.g. a more constructive-critical attitude towards models) (Geertman, 2006, pp. 877-878). Planning support tools should be an integral part of the planning process, they must meet context and user requirements (also proposed by other scholars, notably Lee, 1973; Lee, 1994; Vonk, 2006).

4.5 TOWARDS A BETTER LINK BETWEEN PSS DEMAND AND SUPPLY

For the support of integrated LUT strategy development this means that the focus should be on developing a common LUT language that can bridge both tacit and explicit differences in real-life planning contexts. To face this challenge we have to shift the focus from developing innovative explicit information to incorporating the tacit elements of knowledge, the context specifics of the LUT planning process and the user requirements.

Many other disciplines have dealt with similar challenges in the past. Based on lessons from these fields and integrating these with the context-specificities of planning support, a process framework was proposed that facilitates a constructive and structured dialogue between model developers and planners. This method is shortly introduced below. Then, a case study in which the framework was used to support LUT strategy development is discussed leading to some first findings on how to develop meaningful LUT knowledge.

4.6 MEDIATED PLANNING SUPPORT

The academic foundations of our framework (which we coin ‘mediated planning support’ (MPS)) are comprehensively discussed in a separate paper (Te Brömmelstroet and Schrijnen, 2010). Here, we will limit ourselves to introducing the main elements of the approach (figure 4.1). The core principles are:

- A iterative stepwise approach: to give structure, but take double-loop learning effects into account (Argyris, 2005; Stapleton and Constable, 1997);
- Experience, reflecting, conceptualizing and experiment for every (sub)product, according to the learning cycle of Kolb (1984);
- Socialization, externalization, combination and internalization incorporated in the entire process to link tacit and explicit knowledge (Nonaka, 1994; Nonaka and Konno, 1998);
- From problem definition to defining strategies for an existing planning problem to stay close the questions of the client and make the PSS an integral part of the planning process (Checkland and Scholes, 1990; Lee, 1973; Vonk, 2006);
- Constructive and continuous dialogue between planners and PSS developers (Meadows and Robinsons, 2002; van den Belt, 2004; Vennix et al., 1997);
- Focus on group learning to come to planning LUT strategies (Argyris, 1999; Vennix et al., 1997);
- Use as much standing technologies as possible to overcome acceptance bottlenecks (Vonk et al., 2005);
- Keep it as simple as possible, but not simpler than necessary (Meadows and Robinsons, 2002; van den Belt, 2004).

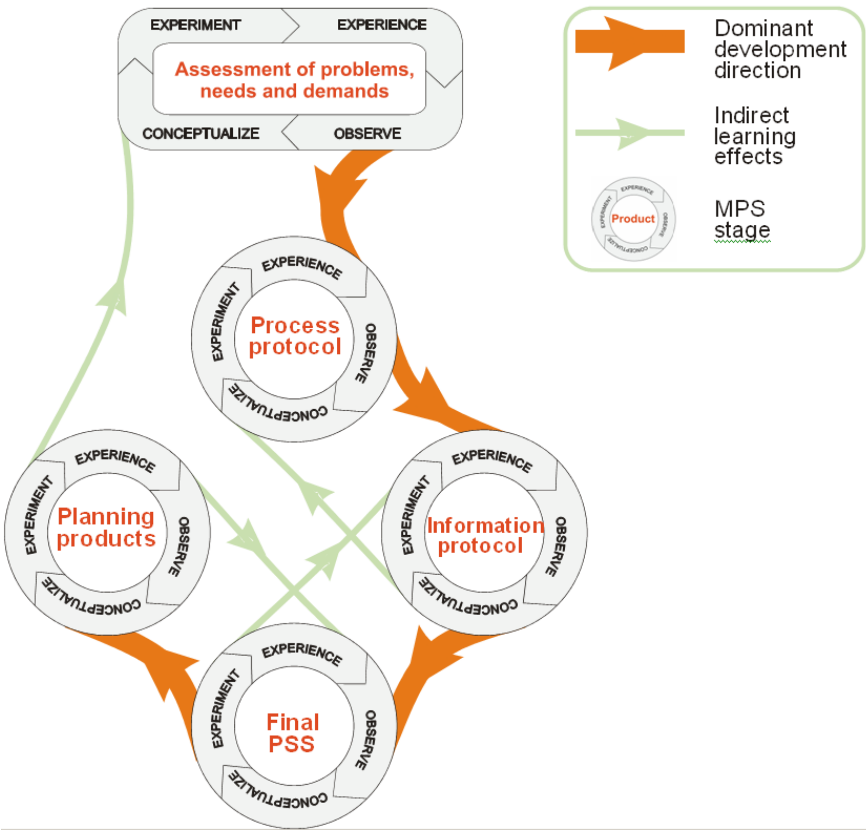

Figure 4.1 The MPS framework

With reference to figure 4.1, a MPS process starts with a focus on the definition of the specific planning problem at hand (in this case the early integration of LUT planning on an urban regional level). At this point, also the group of participants has to be identified (land use planners, transport planners and preferably also stakeholders from both domains), followed by introductory interviews. In this way the participants' views of the planning problem and their expectations of the MPS process and its results are clarified. Subsequently, both a problem definition and a first design brief for a PSS have to be formulated. This is step one of the MPS process.

A series of workshops follows where a planning product and a PSS (process and information) are simultaneously developed. This combination is important, as it creates a continuous testing ground for the intermediate results and fosters mutual learning effects. Working with the PSS also generates new insights in the user's needs. The second MPS step focuses on a *process protocol*, i.e. the necessary steps for arriving at a desired planning product. In the third step, the participants have to identify which information is useful and understandable in each step. In this workshop a first prototype of the common language (*information protocol*) is created. Through dialogue, the PSS developers and planners have to find out what kind of information is seen as useful in supporting the process protocol. By identifying where the information should be used, an information protocol is developed. These first two stages can be seen as a prototype development. Using the protocols and redefining them takes place in the next two stages.

In the fourth stage, this prototype is put to the test; the group of participants has to work with the PSS to arrive at the defined integrated planning product (the desired output is defined by the participants in the first and second stages). Depending on how the group has defined the process protocol, this stage can stretch over multiple workshops. The fifth and last stage focuses on improving the PSS (based on the lessons learned) and on finalizing the planning product. The result is a *final PSS*.

As figure 4.1 shows, the process has a dominant direction, but there are many recursive learning effects (the thin lines). For example, gaining new insights about an ideal sequence of planning steps can lead to a reformulated process protocol (learning by doing), which in turn can lead to new information needs.

Besides addressing the 'implementation gap' of PSS, such an iterative and inclusive approach is believed to foster interaction between tacit and explicit knowledge and to create improved relationships between planners and model developers (see also Ehrmann and Stinson, 1999; Meadows and Robinsons, 2002).

The next section will present a case study in which the MPS approach was used to develop a LUT PSS to support integral strategy development. According to the design oriented research approach, this case is used to find out how the MPS approach works in planning practice and what outcomes such a process would generate: what are requirements for a PSS to support strategic LUT planning? These will have to be tested further in subsequent cases to ground them as 'technological rules' (following Pawson and Tilley, 1997; Van Aken, 2004). To come to these field-tested hypotheses different qualitative research methods and techniques were used before, during and after the workshops. These included participant observation, questionnaires and action research methods (Argyris et al., 1985). Two researchers of the University of Amsterdam and one from Delft University of Technology prepared and attended the workshops. One researcher was chairing and preparing the sessions while the other two were observing the participants. After each session, the participants were individually asked to reflect on the products and the process. In-depth interviews and meetings were held to clarify how the approach was received and what was gained through participating in it.

4.7 MEDIATED PLANNING SUPPORT APPLIED: THE CASE OF AMSTERDAM

MPS was applied to support an integrated LUT strategy development process in the Greater Region of Amsterdam (figure 4.2). This region is a semi-formal cooperation of 16 municipalities surrounding Amsterdam, encompassing about 1.4 million inhabitants. Amsterdam is the biggest and central city in this area. Leading job locations are located in the city centre, at the southern part of Amsterdam and near Schiphol airport.

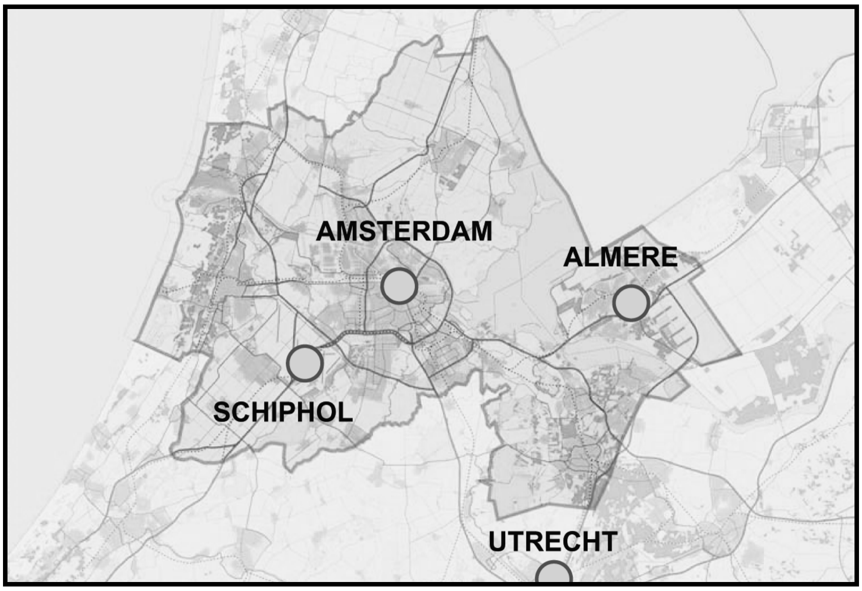

Figure 4.2 Greater Region of Amsterdam

The municipality of Amsterdam is the only Dutch municipality with their own fully functional transportation model – GenMod. It is a static and multimodal four step transportation model based on household surveys and mobility counts. GenMod does not represent the state-of-art looking at models available in research environments, but it can be seen as a common type of transport model applied for planning in the Netherlands (state of practice). Following the MPS principle of using as much as possible standing technologies and the belief of participants that while relatively simple, GenMod could still generate useful (i.e. complex and understandable enough) insights in LUT interaction mechanisms in early, strategic phases of the planning process, it was decided to use it as main source of information. GenMod covers 933 zones and includes extensive car and public transport networks. The model is capable of calculating transportation impacts for land use and transport developments in the Greater Region of Amsterdam. Recent test results have shown that the outcomes of the model are the best available in the Netherlands. Despite this, the model is not used to its full potential (especially in strategic phases of the planning process). It seems that the model is too narrowly focussed on producing rigorous-calculation results, to be used as input for a technical rational planning process. Hence, it is not useful for the (also in Amsterdam much needed) support of LUT integration in early phases. In 2005 the Transportation Planning Department of Amsterdam (DIVV) and the University of Amsterdam thus started cooperation in a project aimed at increasing the usefulness of GenMod for the support of LUT integration in early phases of regional planning (e.g. integral visioning). For this, MPS was implemented.

Involving approximately ten to fifteen participants, the MPS process included six formal meetings, from April 2006 to May 2007. Depending on the particular phase, the group of participants consisted of: two to four transport modellers, four to five transport planners, two land use planners (all from the Amsterdam municipality), one land use planner from the regional authority (Stadsregio Amsterdam), the Dutch Railway company as stakeholder and a group of scientists.

4.8 DEVELOPED MPS PRODUCTS FOR LUT PLANNING SUPPORT

Below, we will discuss the developed products in the initial order of the MPS stages (figure 4.1). This does not always reflect their order of development; due to recursive learning effects, often the products were redefined later in the process, as already discussed above.

4.8.1 *Problem Assessment*

The MPS for early LUT integration started with a session discussing current planning processes, focusing on bottlenecks blocking integration throughout the (cyclical) planning process. One of the conclusions was that transport planners see themselves reacting on already defined land-use plans, instead of jointly participating in earlier planning phases.

It continued with a discussion on the current planning process. According to the participants, planning is a cyclical process. It often starts with either a land use or a transport idea, followed by an internal discussion among (land use *or* transport) experts and stakeholders, where a shared vision is developed. Subsequently, risks, needs and opportunities are analyzed and decision makers have to decide on a “go – no go” basis, often followed by a ‘benefit and necessity’ discussion, which is a long process also involving citizens. This can either lead to the implementation of the land use/transport idea or to a new planning cycle. For concepts developed from a land use perspective there is often no support from the transport side and vice-versa, resulting in mutual competition and potential for conflict in later stages. Improving integration in the early phases (of concept development) would prevent such conflicts. As discussed below, in its current form GenMod is not suited to provide support for this.

A second session focussed on discussing the planning problem that should be addressed in an integral LUT process. The participants agreed on working on alternatives to accommodate the economic growth that the region is expecting until 2030. This growth calls for an addition of 150.000 houses and 150.000 jobs. Also, the infrastructure faces a challenge to accommodate the corresponding traffic. Working on combined transport and land use alternatives was expected to create insights and lessons in to how these challenges can be coped with in an integrated fashion.

4.8.2 *Process Protocol*

In the following workshop the participants discussed which functional process could overcome the identified bottlenecks. The results of this discussion were interpreted by the researchers of the University of Amsterdam, who presented a process protocol in the next workshop. Again, this protocol was discussed (and used), eventually producing the one depicted in figure 4.3a. Key characteristics of the process protocol are:

- The first planning step should focus on generating land use alternatives based on issues of accessibility and sustainability (derived from an analysis of existing urban development programs/trends). In this step, existing land use constraints (e.g. ecological protected areas) have to be considered in order to avoid the development of an overly idealistic LUT strategy.
- In the second step, the alternatives have to be tested on their network implications (e.g. level of service) and on the same indicators as in step 1 to show the dynamics of these indicators. This will lead to an optimizing design exercise (but possibly also to more radical reframing) in which choices made in the various alternatives can be altered. Also infrastructure measures can be introduced here.
- The third step of the process protocol is to analyze and discuss the differences and similarities between the developed alternatives and consequences, in order to discern robust choices for future LUT systems (land use and/or transport planning decisions which are always beneficial) and interdependencies (‘if we want this then we should do that’ or ‘if we do this then we can expect that’). This was considered more useful then drafting a ‘best LUT plan’; supported by the belief that, while central and comprehensive planning of regional LUT developments is not feasible, being aware of broader implications is essential in order to decide and act consistently on specific issues as they appear (e.g. infrastructural projects, local housing development plans).
- Learning effects can lead the participants (ideally also including information providers) to reconsider the LUT choices made earlier in the process (i.e. in the first developed alternatives).

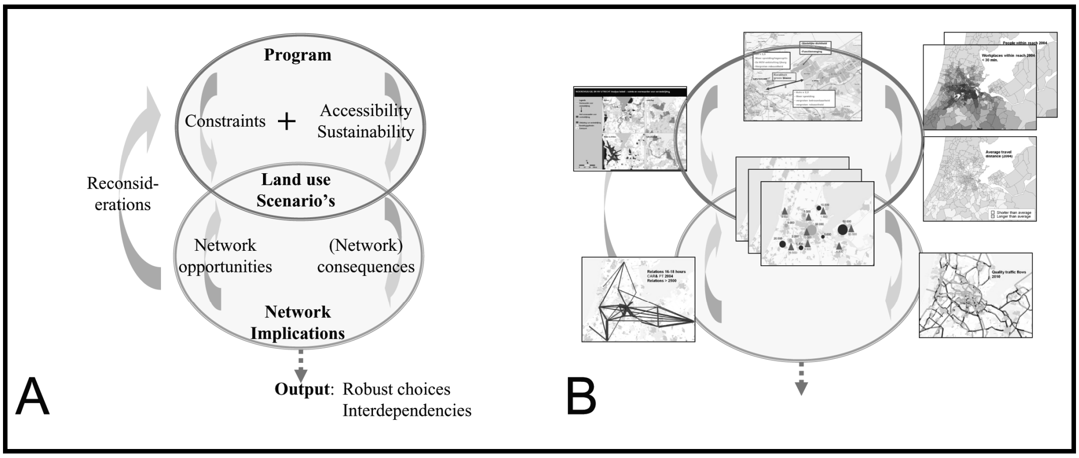

Figure 4.3 The process protocol (A) and the information protocol (B).

4.8.3 Information Protocol

The next step towards the LUT PSS was selecting the preferred information characteristics with the participants in relation to the envisaged process protocol. Discussions and individual exercises revealed that user needs in such a process were very different from the current characteristics of GenMod. The planners acknowledged that the explicit knowledge currently does not link to their tacit knowledge, as was also discussed above. They need a common language to discuss strategies, to sharpen concepts and ideas and to build visions. Characteristics as "detail" and "precision" are considered to be of minimal relevance. GenMod should be used to test existing insights and create new ones, instead of delivering 'facts' and evaluating existing plans and projects. Furthermore, GenMod is neither transparent nor user-friendly, generating a black box feeling. The model should not only predict future macro situations, but also create insight in LUT choices and opportunities. Finally, it was recognized that there are different layers of 'users' (i.e. citizens, stakeholders, experts) with different information needs, a feature that has to be included in a PSS.

The second step towards the information protocol was to judge and discuss the existing LUT information. In a workshop, the participants rated and discussed archetypical LUT maps and data that could be useful. A selection was made and related to the steps in the process protocol. The resulting information protocol (again after iterations of testing) is shown in figure 4.3b. Important characteristics are:

- In the first planning step (constructing the land use alternatives), spatial maps are key. For the design of land use alternatives the participants wanted to know the spatial situation of indicators, such as potential accessibility (e.g. the number of people or jobs accessible from each zone within acceptable travel time) and sustainability (e.g. the number of people or jobs reachable within a crow flight distance [7]). Also spatial constraints have to be considered (e.g. valuable landscape features).

[7] This indicator is seen as a proxy for sustainability, because it shows the number of activities within reach by slow modes (walking and bicycles), or by shorter trips on motorized modes (proximity).

- The LUT information for the first step should in the first place function as a platform for discussions (linking tacit and explicit knowledge). For this purpose the information has to be (1) understandable for all participants, thus transparency of it is crucial (2) qualitative rather than quantitative and (3) simple rather than sophisticated.
- In the following step (showing the LUT consequences of the choices made) GenMod should calculate network consequences (e.g. level of service), network opportunities (e.g. for more efficient use) and the dynamics of the indicators used in the first step. This creates an understanding of which choices have a positive impact on the chosen indicators and which a negative one.
- In the third and final planning step (selecting robust choices and identifying interdependencies) the model should present clear overviews of all indicators and maps. These are then used to facilitate a closing discussion between the participants on the LUT lessons learned and to create a list of appropriate LUT choices and strategies.
- For these two latter steps, the information should sharpen existing ideas and can therefore be more complex. However, to be useful it should be (1) understandable, by explanation and discussion among the participants (2) more quantitative than qualitative and (3) transparent in its assumptions and calculations.

4.8.4 Final LUT PSS

The resulting product of the development approach was the final LUT PSS, a result of testing the proposed process and information protocol in the development of integrated LUT strategies. The participants were overall satisfied with the first version of the process protocol. It seemed that the alternative development and optimisation supported an early integration of LUT planning.

The information protocol as depicted in figure 4.3b was the subject of more group discussion. While everybody agreed on the usefulness of most indicators, the land use planners requested more transparency of the potential accessibility maps; what is included, what is excluded and what are the assumptions. Also, “next to these basic indicators, flexible availability of other relevant information” is desired, according to one land use planner. This is something that has to be improved in the final PSS, which is currently being developed in cooperation with the model developers and the University of Amsterdam. The focus lies on the creation of a ‘GenMod light’, with an increased interactive character and on better documentation to increase the transparency of the information.

4.8.5 Integrated LUT Strategies

The desired end product of the MPS process is not only the final PSS, but an integrated LUT strategy. In the case of Amsterdam, the participants agreed upfront that they did not want to create the best possible alternative from a LUT perspective, but foremost they wanted to improve their insight into LUT relations and the consequences of possible land use and/or transport choices and opportunities. The desired outcome of the process is a list of robust choices for future LUT systems (land use and/or transport planning decisions which seem to work in different scenarios) and interdependencies (‘if we want A then we should do B’ or ‘if we do A then we can expect B’). Both lists should be accompanied by the corresponding information that was used (explicit knowledge) and discussions that took place (tacit knowledge). Such a product can then be presented to other municipalities in the region, to stakeholders and to decision makers.

An example of a robust choice in the case discussed was to: “concentrate land use programs along existing public transport infrastructure corridors”. This was not an entirely new notion, but according to the participants the information provided clearer argument for this idea (currently not applied in land use planning!). Also, an expressed robust choice was to: “stop the expansion of the road network after the current A6-A9 link and optimise the regional public transport network of the Amsterdam region in combination with increasing the densities of the existing built-up areas”.

An example of a LUT interdependency that became evident in the process (as noted by a transport planner) is “if we want to further develop the new town of Almere, *faster* public transport connections have to be developed (not mere capacity expansion) and development should occur only on the Westside of the existing town”. Interestingly and contrary to the official views, the developed land use alternatives also showed that from a LUT perspective the existing program could be developed almost without putting more pressure on Almere. The choice to build more houses there (the government plans to add 60.000 houses there before 2030), does not seem to be logical one from a LUT perspective. Such an intervention will probably result in unsustainable traffic on the road- and rail-links between Almere and Amsterdam. Creating more job opportunities in Almere seems to be a more robust choice. In the same vein, better housing location from a LUT perspective, and still acceptable form other perspectives, were also identified.

4.9 CONCLUSION AND DISCUSSION

This chapter started with signalling the importance of LUT integration and the lack of it in planning practice, especially in early phases of the planning process. It was argued that this was partly due to a substantive barrier. A survey among practitioners in the Netherlands showed that current instruments and PSS that attempt to overcome this barrier are not used, largely because of so-called soft reasons: tacit and explicit knowledge do not seem to match. These findings echoed general research on the implementation gap of PSS and it was proposed to follow guidelines suggested by other academic fields and to construct a structured dialogue between modellers and planners to develop and use existing LUT information for the support of early planning integration: Mediated Planning Support (MPS). This method was applied in the Greater Region of Amsterdam.

The outcome of the MPS process in Amsterdam is twofold; the LUT PSS (consisting of a process and an information protocol) and the shared LUT strategies. Below, we will summarize their main characteristics focussing on possible generic features applicable to other strategic LUT processes. These are presented as first ‘field-tested’ principles, which will be further tested in consecutive cases. In closing the chapter, we reflect on the approach taken and suggestions for further research.

4.9.1 *PSS for strategic land use and transport planning*

The process protocol (figure 4.3a) provided a stepwise approach to get land use and transport planners in a cooperative process of developing shared strategies:

- Starting with a shared concept of the problem statement seems crucial; it can show the planners that the two domains have similar goals and can thus result in shared ideas or strategies.
- Developing alternatives in mixed groups of land use and transport planners is important to get diverging possibilities to solve the LUT problem, to support and guide the discussion between the planners, to learn about system dynamics and to test different strategies.
- The preferred outcome is a shared 'feeling' for the dynamics of LUT relations, as materialized in the identification of robust choices and important interdependencies. This enhances the learning effect (for participants) with a view on informing the negotiations where strategic decisions are made (i.e. by showing cross implications and trade offs of such decisions).

The information protocol (figure 4.3b) shows which kind of explicit information might be useful in which step of the strategy developing process:

- The generation of alternatives seems best supported by geographical mappings of the current situation. This means that some transport issues have to be translated in a geographical indicator (to improve understanding of their spatial implications).
- Simplicity is key: Although the planners and modellers recognized that more complex measures are needed later in the planning process, simple indicators were deemed most useful in this early process. Much 'tacit' awareness about the complexity was already present at the table. Putting it in the indicator could even hamper a fruitful discussion.
- Network maps showing the functioning of important transport links are important for understanding the impacts of the generated alternatives (rather than helping generating them), so they can be compared and optimized (or more radically questioned).
- Most additional information should be provided in the form of a background database (i.e. on a laptop) that can be consulted during discussions; especially the indicators that show the dynamics between alternatives.
- In the final stage (selecting robust choices and identifying interdependencies) graphs are helpful in indicating the impact of certain interventions. It also helps to visualize the variation in impacts between the various alternatives. In particular maps showing the differences in geographical indicators seem to help planners grasp the internal dynamics of the alternatives. Where do certain effects occur when a certain intervention is planned?

4.9.2 *LUT strategies*

The participants mentioned that the primary gain of this process is not (only) new LUT insights, but rather an increased (and perhaps most importantly a shared) awareness of the rationale behind LUT relations and choices. Or even, as one transport planner asserted: "it created insight that existing ideas are not the only ones that make sense". The participants also noted that the process perfected existing ideas and concepts, enriched their evidence-base and created a common language to address these issues. The transport planners emphasized that they now have useful process framework and guidelines, which might allow them to be involved in earlier phases of the planning process.

4.9.3 *The MPS approach as mechanism*

The process in Amsterdam has shown that working through the steps of the MPS framework results in a better fit between the existing transport model and the specific demands of LUT strategy development. Overcoming several of the identified bottlenecks (most notably increased transparency of the tool, increased interactiveness, improved communication value) resulted in more or better argued LUT insights, an improved fit with the planning process and improved support for the *generation* of alternatives, compared with the previous situation.

One of the key mechanisms seems to be the structured discussion and deliberation between the modellers and the planners. The planners feel that they now have more useful information that is understandable and that shows the crucial and relevant LUT relations. Due to the discussions in the workshops, all participants were fully aware of the limitations of the information and the assumptions behind them. This awareness seemed to be a condition for the creative use of the information.

During the process, much attention was given to how the information should be presented to be useful for the planners. The GenMod developers learned that spatial representation of transport impacts is crucial in supporting land use planners; increase and decrease categories ("better", "similar", "worse") communicate better than detailed figures and graphs are useful to compare different designs and interventions.

4.9.4 *Importance of context and further research*

Unlike other regions, the Greater Region of Amsterdam can use a transport model that is managed by the municipality of Amsterdam. This unique situation makes it easier to adapt calculations and output to specific demands by planners. Also, the urban dynamics of the region are higher than that of other regions in the Netherlands, especially with respect to the expected economic growth in the coming decades, resulting in a greater sense of urgency. Moreover, the land use and transport planners in the region and the municipality of Amsterdam are relatively highly educated (Healey, 2007) which might make them more capable and willing to work in innovative settings than those of an average municipality. Finally, the workshops only included planners (and one stakeholder), future cases need to include also decision makers and more stakeholders to see if such an approach can be applied in wider planning settings.

These characteristics may have important implications for the outcomes of the process and the potential to generalize them. Both the MPS approach as mechanism and the outcomes have therefore to be subjected to further testing in other contexts. The integration of more up-to-date models in the planning process should be also experimented with. Such research has to focus on how changes in context affect the usability of the MPS approach and if the LUT PSS features presented here are general principles or have to be adapted.

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