

Reference:

Carton, L.J. (2005) How to cope with map controversies in deliberative policymaking. Paper presented at the international conference "Mapping for Change (PGIS)" Nairobi, September 7-9. Wageningen: CTA.

How to cope with map controversies in deliberative policy making

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Abstract:

This paper investigates the roles that participative mapping activities, known as 'PGIS' play –or can play– in the context of a spatial policy making process. Based on prior research we have noticed that the use of spatial models and geo-information repeatedly deepens the conflict between different actor-coalitions. The debates often focus on particular spots or lines on the map, being an infrastructure, a national park, a development site, etc. Based on the evaluation of various participatory policy processes in the Netherlands, we come to the conclusion that many controversies over (GIS-) maps root in a few typical *core dilemmas*. With help of discourse analysis, a method that we adopted from policy sciences, we have analyzed a few cases in depth. From these case studies, we have elicited *ten* strategies how people dealt with the dilemmas while using map sketches, geo-databases, GIS-analyses, spatial designs or local knowledge. The strategies vary from (1) placing the problem in a wider context –and extending the region represented on the planning maps, through (2) reframing the problem –and recasting the legend items on the map, till (3) acting strategically by manipulating the map picture –for instance by hiding controversial boundaries or by adding 'lightning-rods' on the maps (which shift the attention of stakeholders towards other issues). In this paper, we will discuss the different strategies and we will illustrate them with examples. We aim to contribute to the conference topic by addressing concrete strategies how practitioners can cope with so-called *map controversies* in deliberative policy making.

1. Introduction

"It seems to be distinctly more difficult to reach compromise about cartographic concepts than about verbal ones" Faludi and Waterhout (2002), p. 154.

"Shut up. You must draw what we tell you to draw. You are just the map-maker." Spatial planner in the Game on Space against a landscape designer, December 2003.

"Oh, no worry, that issue is not a problem. We will make a map of that." Quoted internal phrase of collegian GIS-experts, serving as example of how these policy-consultants-being-also-GIS-expert think about maps as panacea for solving disagreements (interview with J. Slinger, Faculty TPM, 2004).

"There must be a procedure for making a policy instrument such as a Water Opportunity Map. Whether it is being produced in a participative setting or not. Can somebody tell me the methodology?" Interim process manager intervening in a deadlock situation at the project Water Opportunity Map Delfland, March 2002.

The above statements show some of the variety how people in practice think of and work with maps. The question of the intervening process manager (last of the above quotes) was posed in the midst of a project aimed at making policy on water management for a semi-urbanized region

of the Netherlands. The process was initiated by the water board and set up as a participative process together with municipalities and other stakeholders. In the middle of the project, there was a huge amount of information, but no oversight, and no agreement. This quote is illustrative for the confusion that arises in many participative processes.

PGIS: Best practices versus controversial policy maps

This paper investigates the various roles that mapping/PGIS activities play in the context of policymaking processes concerning spatial planning and natural resource management. In particular, the paper focuses on situations where maps are surrounded by a lot of discussion.

In the research program Multi Actor Systems (MAS) at the TU Delft, of which this study makes part, multiple cases expose the centrality and importance of Geographic Information Systems (GIS) and map images as conceptual devices in the discussions among actors, in various moments of the policy process. It is clear that these tools attract the attention of the public. While there are multiple instances of 'best practices' where maps, GIS-tools and other advanced ICT-tools are (perceived as) very successful instruments¹, we can also point at moments in several policy processes where the map images –stemming from Geographic Information Systems or otherwise– evoked a lot of discussion and sometimes even resorted in a stubborn controversy². In these studies, we have noticed that the use of spatial models and geo-information repeatedly deepens the conflict between different actor-coalitions.

The same pattern of experiences can be traced in the international discourse on PGIS. The application of the Participatory 3-Dimensional Modelling (P3DM) method represents a clear example of a 'best practice' that is being adopted at several places worldwide, such as The Philippines, Vietnam, India, Ecuador and Fiji (Rambaldi and Callosa-Tarr, 2000; <http://www.iapad.org/>). The method of collecting and explicating indigenous information in a format that is understandable for the participants in large three-dimensional scale models is usually met with enthusiasm at the local communities³.

But especially when the maps are directly oriented at making decisions on natural resource management, the practitioners often run into dilemmas between conflicting interests and limiting conditions due to institutional barriers. Language problems, differences between code of conduct and competition between interests occur. The maps more often than not become sensitive somewhere on the line of data collection, policy formulation or formalization (and implementation) of the policy decision.

The sensitivity of maps is visible in the ESDP process; a project in the 1990s of the European member states to collaboratively develop an international spatial vision. In the ongoing deliberative process, the map images had become so controversial, that none of the explorative policy maps, visualizing scenarios or perceptions on Europe, made it into the final policy document. Waterhout and Faludi (2002), who studied this process of spatial policymaking, identified this as 'the problem of maps' (p. 103).

¹ See amongst others Van der Most, Koppenjan and Bots, 1998; LWI, 1997; Mayer, Bockstael and Valentin, 2003.

² See for instance Van Eeten, 1999; Carton, 2002a.

³ Reading maps that project 3-dimensional data on a 2-dimensional plane in a orthogonal projection, is a typical instrumental skill that has been taught in western educational programs. Map reading has become such a habitual skill that it could be easily forgotten that it is a form of educated literacy to understand the grammar and meanings of a map model, with its projection of the irregular earth surface on a plane 'from above', its map layers or feature classes and its thematic schematization and pictorial symbols.

In this paper, we describe these problems of what we call map controversies. Controversies are characterized by the amount of arguments that add up, while the progress in a policymaking process comes to hold. Eeten (1999) and Koppenjan and Klijn (2004) have described stubborn controversies in policymaking as 'dialogues of the deaf'; the participants turn 'deaf' for the other parties' arguments.

We aim to understand *why processes evolve into conflicts, rendering the maps to become sensitive documents or even forbidden*. Moreover, we aim to provide recommendations to PGIS practitioners, by providing knowledge about concrete options how one can cope with such map controversies.

The paper is structured as follows. We firstly describe the theories we have employed for our empirical exploration. The next section describes the two strands in theory on which this paper is based; cartography and policy analysis. This theory centralizes around the notion of framing. Accordingly, we explain our research method. The succeeding sections present the results, beginning with a diagnosis of the problem followed by ten mechanisms of how people in practice have coped with map controversies. Five of these mechanisms are illustrated with a case example. In the succeeding discussion, we propose a framework for theory building about conflict resolution mechanisms in map controversies. In the concluding section, we summarize the essential ideas of the paper.

2. Theoretic framework: Describing the nature and process of 'framing'

Cartographic background: on maps, power, and way of thinking

In his essay "Maps, Knowledge, and Power" (Harley, 1988, reprinted in 2001), Harley was the first cartographer of his time to envisage 'cartographic images in terms of their political influence in society' (Harley, 1988, p. 277) Harley opposed against cartographic theory that projected maps as "scientific" images. A view which, till then, had been dominant for centuries (Harley, 1988 p. 280). Before Harley, cartographers had theorized about the distinction between 'correct' and 'false' maps and 'objective' versus 'propagandistic' maps. But Harley perceived all maps as *value-laden* images. Adopting the philosophical ideas of Michel Foucault and Anthony Giddens, Harley saw cartography as a socially constructed form of knowledge and power. Pickles (1995, 2004) went a step further. He took up the concept of mapping and cartographic practice as a 'way of seeing' generalized for all practices of modern science. Pickles (2004, p.97): "Indeed cartographic reason seems to have been so powerful a force in the sixteenth and seventeenth centuries that it came to signify the most important forms of reason. *To map was to think.*" Also Pickles refers to Foucault to point out that maps and map-making, in a figurative sense, *produce space*.

A theory about controversies: on frames and framing

Policy analysis, a field dedicated to the provision of knowledge about policymaking and policies, also draws upon work of Foucault and Giddens in describing the 'argumentative turn' or 'linguistic turn' in policy analysis and planning' (Majone, 1989; Fischer and Forester, 1993; Dunn, 1994), which evolved into notions as 'the network perspective on policy analysis' (amongst others Hajer, 1995 and 2003; de Bruijn, Ten Heuvelhof and in't Veld, 2002; Koppenjan and Klijn, 2004; Leeuwis, 2004).

One of the recurring themes in this theoretic stream, which is closely linked to or 'the discourse paradigm in policy analysis', is the appearance of *frames* and processes of *framing*. Martin Rein and Donald Schön (1993) were among the first authors writing exclusively and

explicitly on the concept of actor's frames of reference in policy analysis⁴. They described policy frames as 'taken-for-granted assumptional structures, held by participants in the forums of policy discourse and by actors in policy-making arenas' (Schön and Rein, 1994, p. viii). With their theory, Rein and Schön explain the nature of *controversies* in policymaking, and how these can be studied. They imagine in people's mind a certain frame, which can be understood as a kind of 'mental map' or a system of meaning. When people interact with each other from totally different frames, according to Rein and Schön, the problem of an ongoing controversy does not lie in the different interests or different information sources of actors, but in a conflict between frames. The solution for overcoming this frame conflict should be sought on the level of frames. Schön and Rein call for a reflective inquiry of underlying frame conflicts in policy controversies, and propose *reframing* as a means for overcoming the controversy.

The concept of framing is widely embedded in policy analysis literature, although the use, elaboration and critical analysis of the concept is fragmented. We have structured the various aspects in four subjects in Table 1 (Carton, forthcoming).

Table 1. Characteristics of the concept 'framing'

Characteristic of framing	Examples
1. <i>Appearance</i> of a certain framing of issues	Use of language, metaphors and rhetoric; in the form of textual devices, labels, images, formulae, models and maps.
2. <i>Rationalities</i> underlying different framings	Lines of reasoning, arguments, values, contextual factors and other sources of legitimating.
3. <i>Dynamics</i> of the process of framing in the policy process	The funneling process of problem awareness to decisions, alignment and divergence between frames of reference, reframing the problem issues, boundary work by actors (entangling and separating knowledge processes from policy processes, with 'keep-out-of-my-area-of-expertise behavior').
4. <i>Locus</i> of a framing process in its contextual setting	Actor-network constellation with formed coalitions, organizational setting, institutional configuration (formalized legal and governmental arrangements, forming a governmental regime), and cultural setting in time and space (countries, historical setting, groups feeling a shared identity).

Participants involved in policy analytic activities have implicit values underlying their individual evaluation system –frame– that forms a looking glass through which they rationalize the collective process and their role in it. Particular (stereo-) types of frames of reference have been formulated by Mayer, Van Daalen and Bots (2004). Mayer et al. have formulated six general perspectives on policy analysis practice in their conceptual model called "the hexagon model".

⁴ There are earlier works on 'frames of reference' and 'rationalities' in policy analysis, such as Wildavsky (1979) and Stone (1988), but these works discussed these topics as small part within a larger storyline.

The authors distinguish different types of analysis-modelling-advise activities of which a mixture of more than one is usually apparent in policy analysis studies:

- 1) to research and analyze;
- 2) to design and recommend;
- 3) to advise strategically;
- 4) to mediate;
- 5) to democratize; and
- 6) to clarify values and arguments.

We have adopted this conceptual model and their concurrent values and rationalities as base for identifying, eliciting and distinguishing between competing frames in controversies around maps.

In the theoretical perspective of frames and framing processes, maps are used as a particular, visual language. With their specific appearance –with a map frame, a legend, layers, symbols and certain well-known shaped lines representing coastal and country borders– people quickly recognize geographic map images as spatial representations.

As soon as the map is explicated outside an actor's mind on paper, in digital GIS format or other instrumental device, the map becomes a model independent from its creator and it gets a life of its own. As Van Daalen et. al. (2002) show, computer models in the policy process have multiple roles: as eye-openers in perceiving a new problem; as arguments in dissent by visualizing alternative futures; as vehicles in creating political consensus and as models for management of a particular ecosystem or issue. The role of a model can be different in the eyes of various stakeholders and it can change over time and space. How a model is perceived, depends not only on the appearance of the spatial model, but also on the frame of reference of the users and the context in which the activity is located.

To summarize, cartographic maps and mapmaking have been characteristic for the Western way of thinking in the long history of Western culture. We see the map as a particular model that, by its structure and form, can take up various functions in different situations. We have turned to policy analytic theory on frames to explain the roots of controversies in policy processes. In order to reveal the (implicit) frames of reference of the map users, we have adopted in our framework of analysis the hexagon model of Mayer et. al. (2004). With these notions in mind, we have formulated an exploratory research approach in order to understand the mechanisms among actors that influence the (dynamic) sensitivity of a map.

3. Applying discourse analysis to the practice of participative map use (PGIS)

We have analyzed a limited number of case studies: two in-depth case-studies and about 10-15 smaller case-studies⁵ where GIS and/or maps were used by multiple actors in the practice of policymaking. The two in-depth case studies have been studied, besides document analysis, map analysis and interviews, with inquiry techniques of participant observation and action research. The other case studies rely for a large part on secondary data of other research studies. Most studies fall under the same research program Multi Actor Systems of the Delft University of Technology, of which this paper makes part (See Table 3 in the annex to this paper). All cases are characterized by the central role played by *spatial models* and by a multi-actor approach in which participative cooperation was the central way of working –at least until the moment of emerging conflict. Every case has a certain problem issue with concurrent

⁵ Depending on whether one slices the collected data per instance of map-use, per map model that may have been used repeatedly or per project-where-maps/GIS-is-used, the amount and size of case-studies varies

objective or expectation for a policy decision to be made somewhere along the line or somewhere in the near future. Not every case has a specific advanced GIS-model as the main object of work, but maps are used in all the cases.

From the case-studies, we have elicited the particular *arguments* that actors employed: in expressing their intentions; in using the maps (map use-in-action); and in giving value judgments of the policymaking process. We have combined these insights in actor's arguments with inspection of the used GIS-model or map information and hindsight observations of the (discursive) developments in the particular policy processes as they evolved. Accordingly, the role of the map/GIS information has been interpreted in the context of the wider policy processes. This method of eliciting and studying the arguments of multiple participants in a policy debate is known in policy analysis as discourse analysis (Hajer, 1995 and 2002⁶; Van Eeten, 1999; Howarth et. al., 2000). In our analysis of the arguments in a discourse, we have included the arguments enclosed in the (construction of the) map images by close reading of their content and appearance using cartographic theory of Bertin (1967), Harley (1989) and Monmonnier (1991). These cartographers have defined and analyzed the structure and the different parts of (the construction of) a map.

The goal of this discourse analysis is to reflect on the process of 'framing' as it has manifested itself in practices, and the role of maps in these processes. We see maps and GIS not only as communication channel for getting through arguments, but also for facilitating a collaborative process of *sense making and meaning construction*; by deliberately discovering, exploring, formulating and assessing new arguments.

4. Results: Conflict resolution mechanisms in (latent) map controversies

Problem diagnosis

In controversies around maps, the debates often focus on particular spots or lines on the map, being an infrastructure, a national park, a development site, etc. Based on the evaluation of various participatory policy processes, we come to the conclusion that many controversies over (GIS-) maps root in a few typical *core dilemmas* that are inherent in spatial planning. The National Landscape Advisor of the Netherlands, Dirk Sijmons summarized these dilemmas as follows:

"In essence, the profession of spatial planners is about coping with the following dilemmas:

- Local interests versus state interests;
- Urban versus rural needs;
- Economic versus ecologic interests;
- Long term problems against short term needs;
- Homogeneity or differentiation;
- To spread land use functions –everything everywhere– or to concentrate differentiated land use functions;
- Uncertainty versus significance and validity;
- Restrictive land use policies or pro-active policies that allow and facilitate development".

(Sijmons, verbal statement at the Lecture "What is spatial planning?", organized by the Netherlands Institute for Spatial Planning and Housing (NIROV) on June 26th 2003 at the Netherlands Architecture Institute in Rotterdam)

With their visible boundaries, their various scale levels, and their clearly defined legend items, map-based models have an underlying conceptual structure that embodies the difficult choices

⁶ See also Hajer's editorial at <http://www.essex.ac.uk/ecpr/publications/eps/onlineissues/autumn2002/research/hajer.htm>

in spatial dilemmas as described by Sijmons. Tensions around maps are, by their form and structure⁷ coupled with the inherent dilemmas in spatial policymaking, such as the emergence of conflict around borders on maps. The image of the map/GIS model makes these tensions visible; it clarifies boundaries, it visualizes the spatial consequences of alternative policies and it offers overview because of the possibility of what Tufte (1990) calls ‘micro-macro reading’ by the human eye.

How actors coped with map controversies: Mechanisms distinguished from practice

We have identified a number of *mechanisms* how maps/GIS have functioned as a device in participative policymaking processes. These mechanisms stem from observed strategies how people actually dealt with the tensions inherent in map models while using sketches, geo-databases, GIS-analyses, map images or spatial designs. We have enumerated ten of these mechanisms in Table 2. We have structured the mechanisms according to the characteristics of framing as described in Table 1.

Table 2. Overview of ten mechanisms how is coped with map controversies

Mechanisms:	Explanation:
<i>Appearance of the problem</i>	
1. Widen scope of the formulated project	When not all objectives of the group or official regulations can be met, for instance because the law enforces that compensation of environmental values is necessary (as is laid down in procedures for Environmental Impact Assessment), an obvious option is to widen the scope of the area so that literally, room for compensation is included. The scope can also be increased by extending the time-period, the number and kind of issues involved, or the actors included.
2. Narrow the scope of the project	Actors make a move that can be interpret as an ‘escape forward’: Employment of this mechanism manifests itself in proposals like “let’s decide on ‘this’ while deciding to mitigate on ‘that’ later”, in order to “be able to finalize the map/GIS product for the time being”.
<i>Rationalities among participants</i>	
3. Employ strategic communication and cartographic rhetoric	This category includes the deliberative ‘tricks’ for propaganda purposes with maps as described in ‘How to lie with maps’ by Monmonnier (1991). But manipulation of maps and policy texts is also applied to be precise in representations, to punctuate the ‘appropriate tone of voice’ on paper and indeed, to optimize the persuasive power. Also to shift attention away from sensitive issues (e.g. the drawbacks of the proposed policy option) towards the unifying aspects (e.g. the non-disputed benefits). On maps various techniques are available, like adjusting colors, line-thickness, change graphic variables, thematic selections, etc. The mechanism manifests itself when detailed attention is dedicated to change the appearance of a map image before publication.
4. Turn to meta-communication	Use the maps to reflect on the frames of reference underlying the map. Instead of ‘carrying on’, a moment of reflection takes over the discussion and feedback is asked about recent communications and

⁷ In ontological sense, as illustrated by Pickles (2004), a controversy over a map has the same roots as the conflict over the spatial issue because we perceive spatial dilemmas with the same pattern of thinking as with which we constitute maps. The debate about the dilemma is transferred from ‘the field’ onto the paper or digital knowledge domain where it is translated into a map model.

practices. This mechanism is visible in the large number of questions asked about 'why' the map is visualized as it is, why certain data is needed/lacking, what reasons are behind voiced concerns and rejections.

Dynamic framing process from problem to decision

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| 5. Reframe the problem | Reframing means the altering of an existing project formulation and information infrastructure around well-established perceptions of reality. The present realities with concurrent classification system and vocabulary have particular labels of what 'the problem' or 'the opportunity' is, thereby rendering the underlying descriptive, normative and prescriptive assumptions invisible and taken-for-granted. By <i>rethinking who views what as a problem and why</i> , a new agenda for deliberation is being formulated, that challenges the formerly presupposed conditions of a project. In spatial models, this mechanism manifests itself in a debate over geo-object classifications, their ontologies (including aspects like generalization level and accuracy) and a reshuffling of the order and grouping of feature classes -in GIS- or legend items -on a map. |
| 6. Mediate choices adaptively | What 'lay-people' and policymakers may consider as 'negotiation', engineers tend to consider as an activity of 'design'. Especially when performed in interdisciplinary collaboration, a lot of information is mediated among several experts and adaptations are made iteratively. This mechanism is often characterized by a 'smooth' or rather silent cooperation between closed groups of participants, who spend considered time and effort on little adjustments and incremental trade-offs between specified and progressively quantified factors. Borders on maps can be drawn in more detail and be adjusted 'a little bit to the North'. |

Framing dynamics of working with a specific model

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| 7. Let the map model do its work | This mechanism forms the 'base alternative'; meaning that nothing is done. The actor who employs this strategy uses phrases (in internal discussions with aligned partners) like "let's see what happens". Others may 'accuse' him of a laissez-faire attitude. While time progresses, discussions about the map may be clarified or run irrelative because of new (externally driven) circumstances. |
| 8. Put the map model (or parts of it) aside | We have seen moments where actors decide to 'park' the maps, which concurrent discussions are felt as more problematic than useful. Discussions may carry on about other than spatial dimensions (such as financial aspects or issues about actor relations). The GIS information or map layer is temporarily being neglected. |

Locus of the map in its context

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| 9. Use the hierarchical organizational structure to solve the dispute | In term of GIS and map use, this mechanism means not to solve a particular conflict at the negotiation table, but instead, to 'push' the debate to other levels of governance. For instance, it can be decided that a particular design choice for a spatial plan is a 'political matter', where the political representatives must decide on. Instead of progressing with GIS-modeling or map-making, the questions under concern are sent to other organizational levels. |
| 10. Empower new dynamics by shifting from talking to action | While talking and talking evoke reflection and mediation, it may not bring potential decisions at closer distance to the participants. In order to collect more information, or to design and detail possible policy options, it is often decided to give some groups (experts, workshop participants, project members) homework. The mechanism |

manifests itself by assigned or spontaneous projects of (P)PGIS with the starting to work on GIS-models and production of policy maps, rather than keep on with unfruitful deliberations about the map conflict.

We acknowledge that these mechanisms are not complete, and that some mechanisms partially overlap each other. However, instead of theorizing about the complete range of natures, causes and effects of controversies around map use, we dedicate this paper to practical ways of how practitioners can cope with them. Therefore, we have described a small number of mechanisms that we have seen in action. The above mechanisms have been clustered in pairs. Because of limited space, we will discuss five of these mechanisms; one of each category. In the next sections, mechanism 1,3,5,7 and 9 are explained with help of a case illustration. In selecting these instances, we have not included mere success stories, but instead, have picked a few of the severest forms of map controversy.⁸

4.1. Mechanism 1: Unfruitful attempts to stimulate creativity by widening the scope on the maps

A case example which resulted in a less-satisfactory result was the case of planning the High Speed Infrastructure through a city center. A participative process with a number of workshops was put in place in order to explore possible extra alternatives, and improve the current preferred alternative of the national government, with help of local knowledge and local creativity of the people living in the area. The process-facilitators used of maps with the expectation that these would serve as device for stimulating creativity and innovative ideas. However, it did not work. Enserink and Monnikhof (2000): "Visualizing new preferred solutions proved harder than voicing concerns and issues... One group had difficulty in starting to sketch alternatives and got stuck in endless deliberations." Although the facilitators had provided maps of a much wider area, the alternatives that were developed by the participants remained restricted to a few construction variants of the same, existing route (see figure 1).

The explanation of the facilitators for this 'no-effect' result comprised the following: The local political representatives cannot think in terms of creativity, design and *innovation*. They are stuck in their limited, funneled *governance* think-frame; *Strategic* arguments were dominant in the process; the national railway company, who participated in the process as expert, wanted to 'keep all their options open for the future' and expressed all sorts of objections to 'wild' alternatives (interview with the facilitators).

Conclusion: Widening of narrowing the scope of a project seems to be a strategic and pragmatic instrument to cope with tensions in a project. In the case example, the political representatives were not persuaded to step out of the existing 'policy envelop' around the planned infrastructure route. The attempts of the facilitators to widen the scope proved unfruitful. The participants kept the spatial scope as it was.

⁸ For an extended example of actors employing cartographic rhetoric, frame reflection, reframing and mediation during one particular project of policy map building, see the running case in Carton and Enserink (forthcoming in 2005).

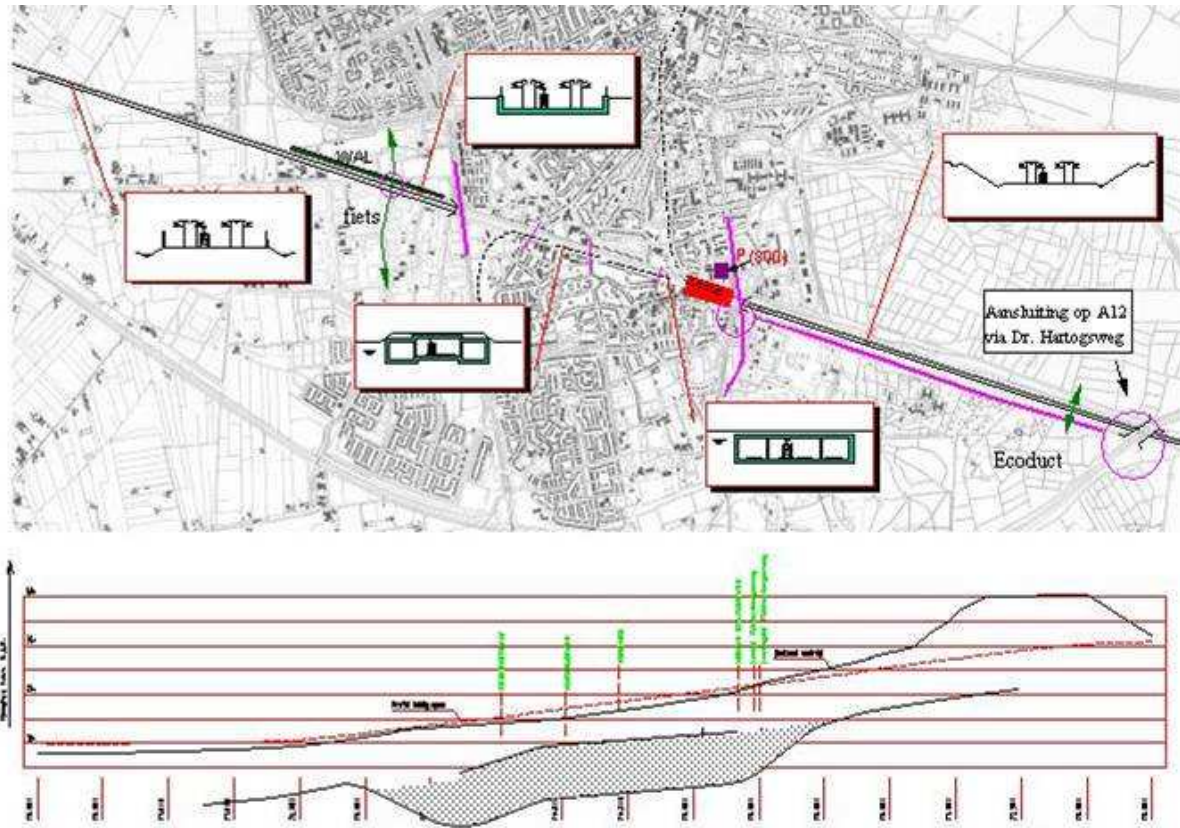


Figure 1. Map of one alternative for the the High Speed Train (HST) infrastructure through the city of Ede. This image is a fragment of the wider-area-map provided by the facilitators (Source: Enserink. Project presentation “COB-N440-2 Praktijktoets Quick Scan Inpassing Spoorverdubbeling Ede” in 1999).

4.2. Mechanism 3: Strategic communication and cartographic rhetoric of noise contours in policy discussion around airport Schiphol

In the Netherlands, the expansion of the national airport has a long deliberative history. The discussion over the expansion of the Dutch national airport in a densely urbanized area keeps on going, between the airport authority, the national government, municipal representatives (mayors), experts, stakeholder groups (especially environmental action groups) and citizens. Currently, the system of restricting the amount of airplane landings based on modeled noise load within certain ‘noise contours’ has become a controversial issue.

The two-faceted objective for Schiphol, as it has been formulated by the Dutch government, is to provide way for expansion for the airport and simultaneously establish boundaries to its environmental burden. In 1996, the government has decided on an official threshold stating what noise is allowed where in the future: a noise load of “35 Ke” or more is allowed for a maximum of 10.000 houses.

In 1999, a new norm system is proposed for the allowance of yearly landings at Schiphol under a regime that would keep the noise-load within limits. The new norm system uses a combination of factors to determine if Schiphol exceeds its allowed noise production. The national parliament doubts whether the proposed norms will have the protective working as the old agreement of 1996. Therefore, the so-called commission Berkhout was founded in 2000, with independent experts.

The commission Berkhout criticized the proposed system, stating explicitly that the proposed locations for measuring the noise, located near the so-called ‘35 Ke contour’ is not wise. For a number of reasons, the noise should not be measured only on a mental construct of a calculated contour. The commission reasoned that the noise disturbance in the area *outside* the 35 Ke contour should be considered too. Berkhout proposed an alternative system for determining and measuring noise load. He explains this in (Berkhout, 2003) with a number of map images (see figure 2, middle and right) together with an explanatory text describing the management of noise with a *metaphor of a hillside landscape* around Schiphol, where the ‘hills’ are levels of yearly noise loads on various locations. Berkhout estimates that a minimum of 19 proposed extra Points for Legal Maintenance is necessary, see map of figure 2 (right). This map is constituted on the logic that, no matter where noise disturbance is expected due to calculations and estimations, the real noise disturbance must be measured, on those locations where the people whose sleeping rest is at stake experience the disturbance (and not on a calculated contour-line where cows occupy the empty grasslands). Note that Berkhout did not visualize his “hillside landscape” of noise on the map with his proposal (figure 2, right image). This, while he could easily have used the cartographic technique of isolines for this purpose, like is normal in maps of mountainous landscapes. It is possible that Berkhout’s noise hills are dynamic or that he just did not take the effort. But it can also be a strategic move not to visualize any boundaries in this stadium, where any information on ‘who on the ground get the noise burden’ is extremely sensitive.

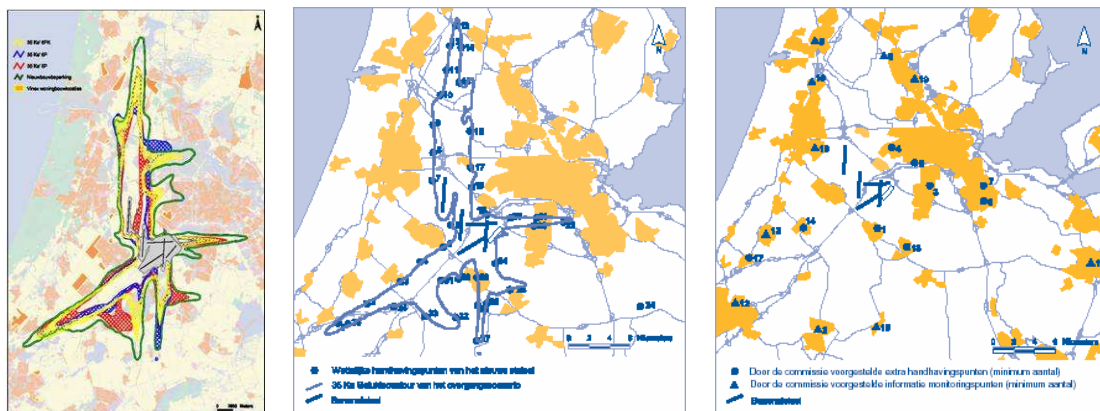


Figure 2. Maps on Schiphol's noise disturbance. Left: Calculations with noise contours to assess impacts of new runways on noise load (source: CPB, 2002). Middle: Map of the current Points for Legal Maintenance, situated on the 35 Ke contour, belonging to the new norm system of the government. Right: Proposed locations for ‘Points for Legal Maintenance’ by commission Berkhout. (source: Berkhout, 2003).

In December 2002, the commission of Berkhout broke up their work and returned their unfinished assignment to the ministry. They disagreed on their task and allowed ‘space’ for doing their research. The government just dismissed the Commission and carried on with as they had planned. In the resulting media conflict Berkhout exclaimed that the implemented norm system and the accompanying governmental decision-making process was a ‘curtain of smoke’, misleading Dutch citizens and failing as democratic process.

Today, in succession of the advice of Berkhout, a parallel network for measuring the noise load is being rolled out (next to the existing official network that serves as control system for the yearly allowance of airplane landings). This network is not implemented by the national government or the airport authority but as counter-initiative by local city-governments and

environmental action groups⁹. Meanwhile, the government has continued the evaluation of the expansion of Schiphol, while including a ‘citizen panel’ to re-establish trust between citizens and the national government¹⁰.

In this case-example, despite of the rhetoric with contour-maps and maps with virtual landscapes arguing for and against noise-measurement-and-control-systems, the conflict over noise continues. One could conclude that the map with Berkhou’s counter-proposal for a more legitimate noise control system did not succeed. On the other hand, in second instance, Berkhou’s map mobilized local groups to constitute their own source of data with, in this case, an alternative noise-measurement system owed by themselves. This alternative measurement-system and its mapping on maps, is a tool comparable with locally owned PGIS. In this case, the ‘underdog’ parties realized they should unite and gather their own data, in order to strengthen their position in the ongoing controversy. Otherwise, the maps not favorable for the airport authority, such as the proposed map of Berkhou, would just be put aside.

4.3. Mechanism 5: Reframing the policy issue of the Green Heart controversy: Moving beyond the ‘one-area – one map layer – one identity’ metaphor

According to stories, Albert Plesman who was a legendary director of the Dutch royal airlines first discovered the Green Heart in the 1930s. He looked down from his cockpit, flying over the western part of the Netherlands, and saw a ring-like pattern of settlements, with an open space as its heart. From this time, the region is perceived as a city ring with an open, green, space in the middle. The Green Heart entered the planning community and waned until this day (Van Eeten, 1999, p. 91-111) (see figure 3, left image).

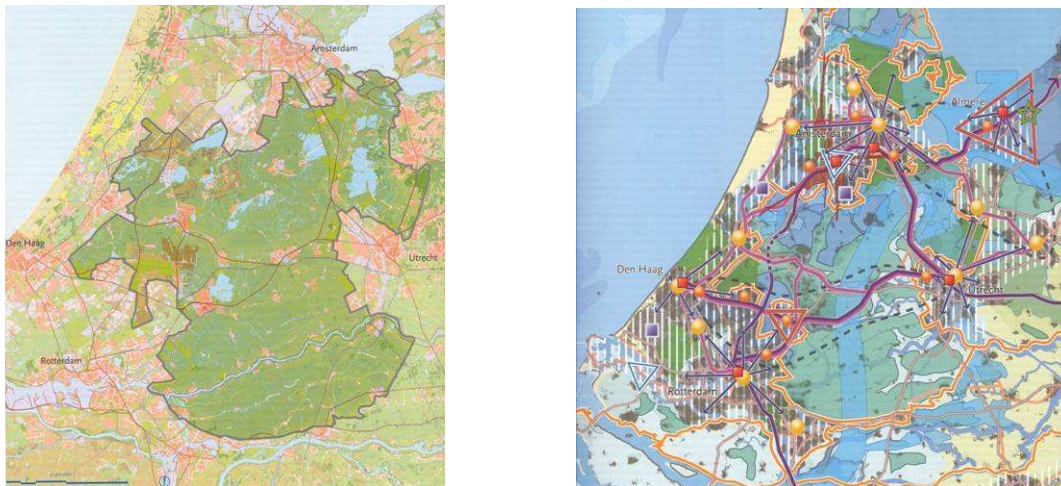


Figure 3. Left image: Map of the Green Heart. Right image: Map of the Deltametropolis. (Source: National Policy Document on Spatial Planning Part 3 by VROM, 2001)

⁹ Source: Friends of the Earths Netherlands (2005) Geluid meten, eenvoudiger dan u denkt http://www.milieudefensie.nl/verkeer/visie/schiphol/schiphol_2.htm (last visited July 25th, 2005)

¹⁰ Source: Ministry of Transport, Public Works and Water Management, Evaluation of Schiphol policy http://www.evaluatieschiphol.nl/html/informatie_4.html (last visited July 27th 2005)

The public dispute on validity or fictionality of the Green Heart concept had been roaring for years. Van Eeten diagnoses that the viewpoints have been flattened and polarized into two opposing lines of argumentation: “the Green Heart concept as valid basis for spatial planning” versus “the Green Heart concept as fiction”. The policy discourse is characterized by ‘an unrecognized paradox of fictionality and authority embodied in the Green Heart concept, rendering the arguments immune to each other’, and thus paralyzing the policy process (p. 147). The author criticizes that the basis of spatial planners’ arguments mainly seem to rely on a metaphoric ‘heart’ that exists only on maps (p. 109): “If a concept so clearly signals its main rationale is to capture the ‘essence’ of a map image, then one should not be surprised that all criticism is channeled into attempts to show that the concept does not accurately represent the map.” Van Eeten advises here to move beyond the fixation in a linear chain of thinking on ‘one area – one map – one concept – one identity’. Differentiation of landscapes, carefully planned new country estates, improved recreational facilities such as cycling roads and a pro-active and financially fuelled protection of ecologically core environments could improve the combined functions of the area as a heterogeneous whole (interview with Van Eeten). He also advises to “move towards other kinds of planning concepts that do not try to fix spatial identities through iconographical readings of maps and cartographical imaging” (p. 147).

Illustrative in this respect is the Deltametropolis initiative, in which the main cities surrounding the green hart have united and presented themselves as the main economic area. In a policy map inspired by this Deltametropolis idea the emphasis is on the urban sprawl and the main infrastructure connecting the cities rather than on the empty green heart (see figure 3, right image). By painting the connecting roads and railways as thick, purple lines and placing a symbol of a yellow circle¹¹ on the locations of the cities, the overall image reflects a harmonious, brightly colored cartographic composition which shifts the attention away from the seemingly “underlying” data-layer of the Green Heart structure, here visualized with darker, more modest green-blue colors.

4.4. Mechanism 7: Letting the map do its work in appointing protected areas in French Polynesia’s waters

One of many examples where PGIS has served a role –in compensating for a technocratic approach of governmental side and ‘getting things straight’ for local communities– is the case of pointing out marine protected areas in French Polynesia. In a research project concerning the creation of a community-based GIS in French Polynesia, Walker (2001, 2003) has studied the process and effects of establishing a system of marine protected areas in a plan making process called PGEM (Plan de Gestion de l’Espace, Marine Space Management Plan). A community-based GIS would be created, in which all lagoon users would have the opportunity to create, up-date, disseminate, and aquire knowledge about the lagoon in a spatial context. But even though the process was intended as participative action, the project did not turn out as an example of “smooth” practice of (P)GIS. During the process, Walker ran into the controversial nature of maps in the conflict between the Ministry of Urbanism of the state, fishers, hotel owners and lagoon tour operators over the definitions and spatial parameters of lagoon habitats, ecology, and management (see the four maps of figure 4).

Walker (2003): “The maps produced by the government seemed “scientific” and “official,” making them difficult to refute by stakeholders [...] The use of these maps in the PGEM decision-making meetings limited the ability of many stakeholders to insert their cognition of the marine environment into the maps or the decision-making process. In addition, stakeholders felt that important uses and meanings of the lagoon - such as the non-economic value and the

¹¹ The yellow circles are seemingly illuminated by a light spot in the upper part of the circle which “lifts” the cities of the map, at least in Tufte’s (1990) meaning of insinuating depth in pictorial information.

spiritual meanings associated with certain areas - could not be identified, quantified, or mapped within the confines of a digital database, or on an analog map for that matter. Stakeholders voiced anger and frustration at not having access to, or knowledge of the computer mapping technology used. At the same time, stakeholders were reluctant to provide their own data to the PGEM policy-makers because they did not trust the state to input or analyze their marine knowledge fairly in the GIS.”

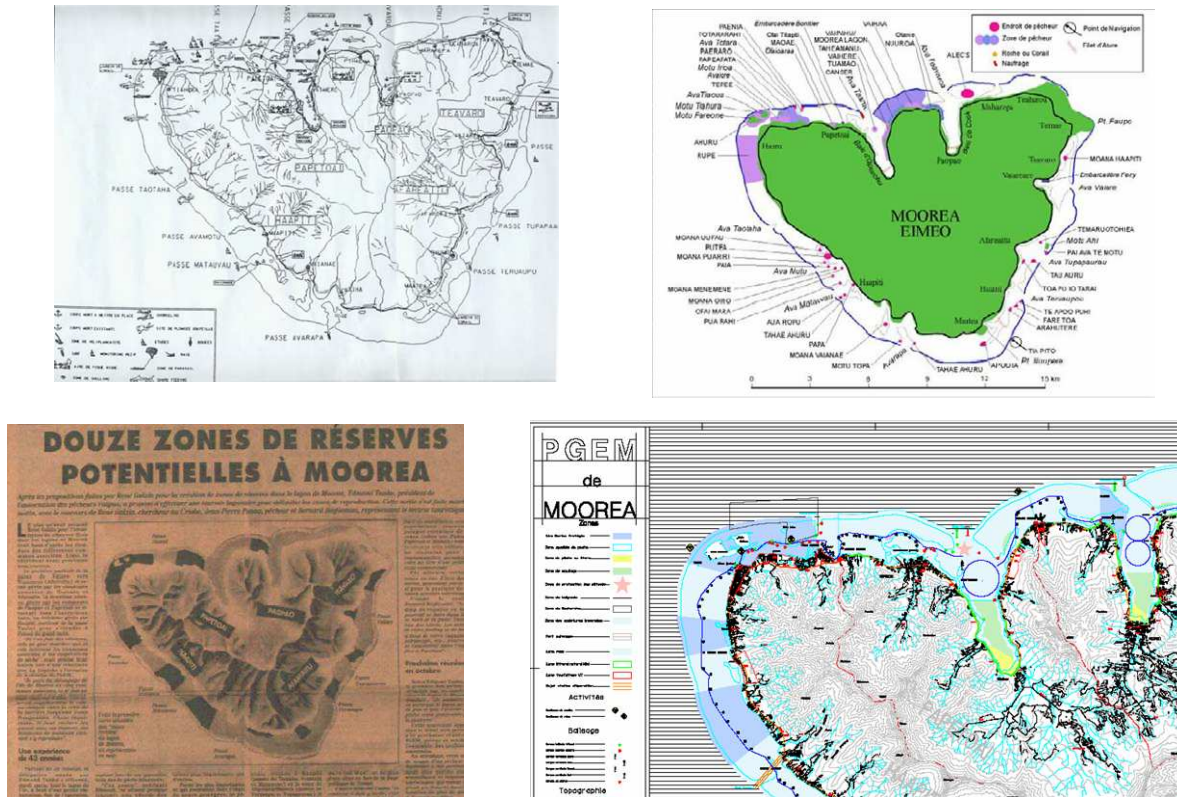


Figure 4. Maps made and used during the PGEM process. Upper left: Early PGEM map. Lower left: Map in the newspaper that fuelled the controversy. Upper right: Fisher’s map made in the Public Participation GIS project as a reaction on the official PGEM process. Lower right: Fragment of the new PGEM map after deliberation between stakeholders and government. Note the difference between the marked (shaded) protected areas between the lower left and lower right map images (Sources: Stonich, 2002; <http://moorea.berkeley.edu/maps/index.html>)

The governmental bureaucrats would not incorporate diverse interpretations of the lagoon and its resources into the official PGEM decision-making maps. They preferred the scientific knowledge of biologists, which conflicted with knowledge of Maohi’s (society islander), which relied on their life-long, daily interactions with the organisms in the lagoon and traditional lagoon management and fishing laws. As a reaction, the Maohi organized extended, lengthy public protest actions and formed own associations (see the newspaper fragment in figure 4, lower left image). The process of mapping the protected areas was put on hold. In the next municipal elections in 2001, the PNEM process was an important issue.

Walker (2001): “In their inadequate attempts to invite public participation, the government ironically alienated stakeholders through the privileged use of GIS decision-making which was not accessible to the majority of Moorea’s stakeholders. As a result, stakeholders eventually became willing to participate, although not in the ways that the government had hoped. Instead, they formed politicized and organized local associations which are not necessarily “for” the

environment in the Western sense of environmentalism, but rather for their own livelihoods and sovereignty, and against government interference...”

4.5. Mechanism 9: Using the hierarchical organizational structure to solve the dispute in developing Water Opportunity Maps

The water board Delfland is situated in a densely populated areas in the Netherlands, where repeated floods occurred in recent years. Between 2000 and 2004, the water board has developed a strategic vision on water management in participation with municipalities of the area. The people working at the Delfland organization agreed after finalizing the first pilot-area after more than two years, that the resulting policy document called ‘Water Opportunity Map’ was of good quality but that the process had taken too much time and effort. The pilot project had gone through a number of conflicts around maps (Carton and Enserink, forthcoming in 2005). In the next three areas that had to be considered, the decisions taken during the data collection and design activities should be speeded up and be divided more efficiently over participative activities (workshops with stakeholders) and desk work executed by the water boards’ experts and hired professionals. After consulting a group of policy analysts (including us), the project adopted a decision scheme for pushing controversial decisions out of the project and into the ‘management line’ of the water board organization (see figure 5). This way, the project team had less ‘negotiation space’ for interacting and collaboratively designing with external stakeholders. But the working procedures and decision responsibilities within the water board organization were reconsidered, re-clarified and reset. The ‘upward’ and ‘downward’ traveling of decisions between project team level and management team level thereby became more transparent.

This may sound totally evident to many people. But measured against the enthusiasm and satisfaction with which the process management guidelines were received by employees and representatives of all levels within the water board organization, it seems like writing such procedures down in a schematic roadmap of decisions to be made, can be helpful, or at least be conceived as helpful.

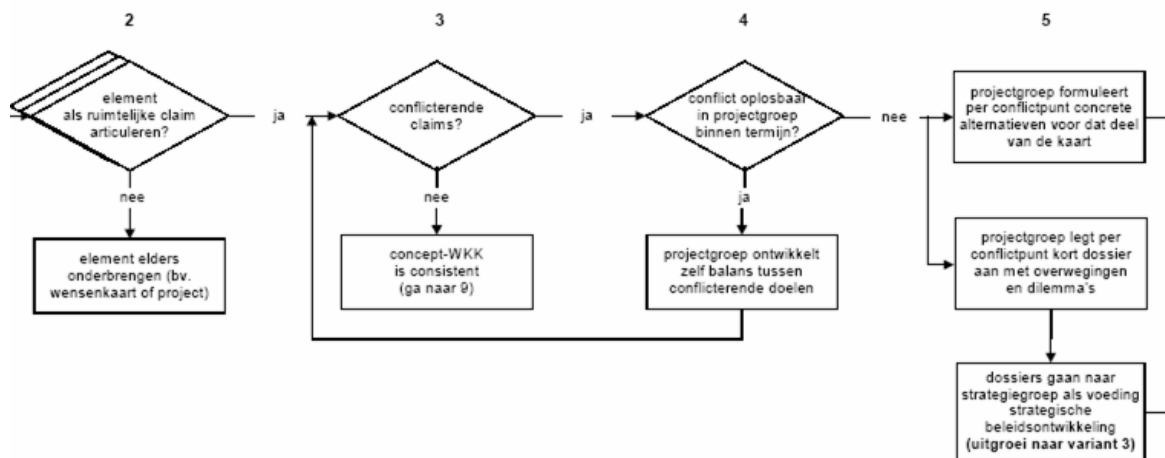


Figure 5. Fragment of the proposed scheme for process management in Delfland. In the three boxes at the right, steps are visualized to push a conflict issue out of the project (In Dutch. Source: Van Eeten et. al., 2002).

5. Discussion: Towards a framework for conflict resolution mechanisms

We have described five conflict resolution mechanisms that have been exploited by actors in practice, with different consequences and variable success. We have described these mechanisms in order to show a certain pattern in the variety of practices with map-use-in-action. The identified mechanisms are part of work in progress. Their current formulations are rather generic, they need further specification and contextual refinement. We conceive the articulated mechanisms as attempts or strategies of actors to enforce a few specific types of ‘movements’ upon a deliberative process, which we have denoted as *framing*, *unfreezing*, *fencing* and *reframing*.¹² Further research will be dedicated to these movements in deliberative practices, and how they can be supported (by PGIS and other methods and techniques).

In the analysis, the structure of the hexagon model with six alternative perspectives on the practice of policymaking of Mayer et. al. (2004) served as a checklist for diagnosing the nature of the conflict around the maps. The conflicts that we found around maps could indeed be traced back to a clash between frames of reference. Although we cannot yet prove it with strong evidence, we also found, that when a map controversy was diagnosed as a conflict typically between actors with a ‘research-and-analysis frame’ and actors with a ‘democratization frame’, the way out of the controversy (as it actually happened) was rooted in other frames than these two clashing ones.

For instance, in the Schiphol case, the controversy around noise contours was centred around a fact-finding approach by Berkhouts commission [frame: research and analyze], advising a radical change [frame: design and recommend] while the government was busy with strategic politics aiming at good governance [frame: advice strategically] while mediating between economic and ecologic interests [frame: mediate]. The way out of the deadlock, as it is happening presently, is characterized by a reflection on values and on the process so far with the evaluation by the government [frame: clarify values and arguments] and by democratization, namely with municipalities measuring the noise themselves and a government inviting participants to the evaluation, in order to restore trust between the polarized actor-coalitions [frame: democratize]. In the French Polynesian case, the initially democratic (participative) approach by the policymakers did not prevent that the fact-finding approach of bureaucrats and biologists [frame: scientific research] clashed with the cultural, traditional and tacit (life-long engaged) knowledge of the indigenous fishers [frame: clarifying cultural values and explicating tacit argumentations]. These groups strategically mobilized protest and organized themselves in associations, forming an alternative vision of what ‘good governance’ for the island would look like and influencing the next democratic elections.

Proposing a strategy for PGIS practitioners how to cope with map controversies

As a result, we propose the hexagon model of Mayer et. Al. (2004), as a tool for diagnosing and coping with map controversies. We have made some adaptations.

In our terminology, the six perspectives can be viewed as six categories of conflict resolution mechanisms. We have renamed these categories or dimensions of conflict resolution as:

- 1) Fact finding;
- 2) Innovation;
- 3) Strategic governance;
- 4) Diplomacy;
- 5) Democratic rules and
- 6) Debate/frame reflection.

¹² Framing and reframing are explained in the text. With unfreezing we mean the opposite of framing, which renders the evolved framing as questionable. It often means that other framings of the issue are being considered (but unfreezing does not automatically imply a reframing of the problem). Fencing means the attempt to consolidate a current framing –of substantial issues, of a certain process or of institutional divisions of responsibilities– by putting up boundaries and keeping other options ‘out’.

These categories rely on the six perspectives of Mayer et al, to which we refer as ‘action rationalities’. An overview of the hexagon model in this adapted form is visualized in figure 6.

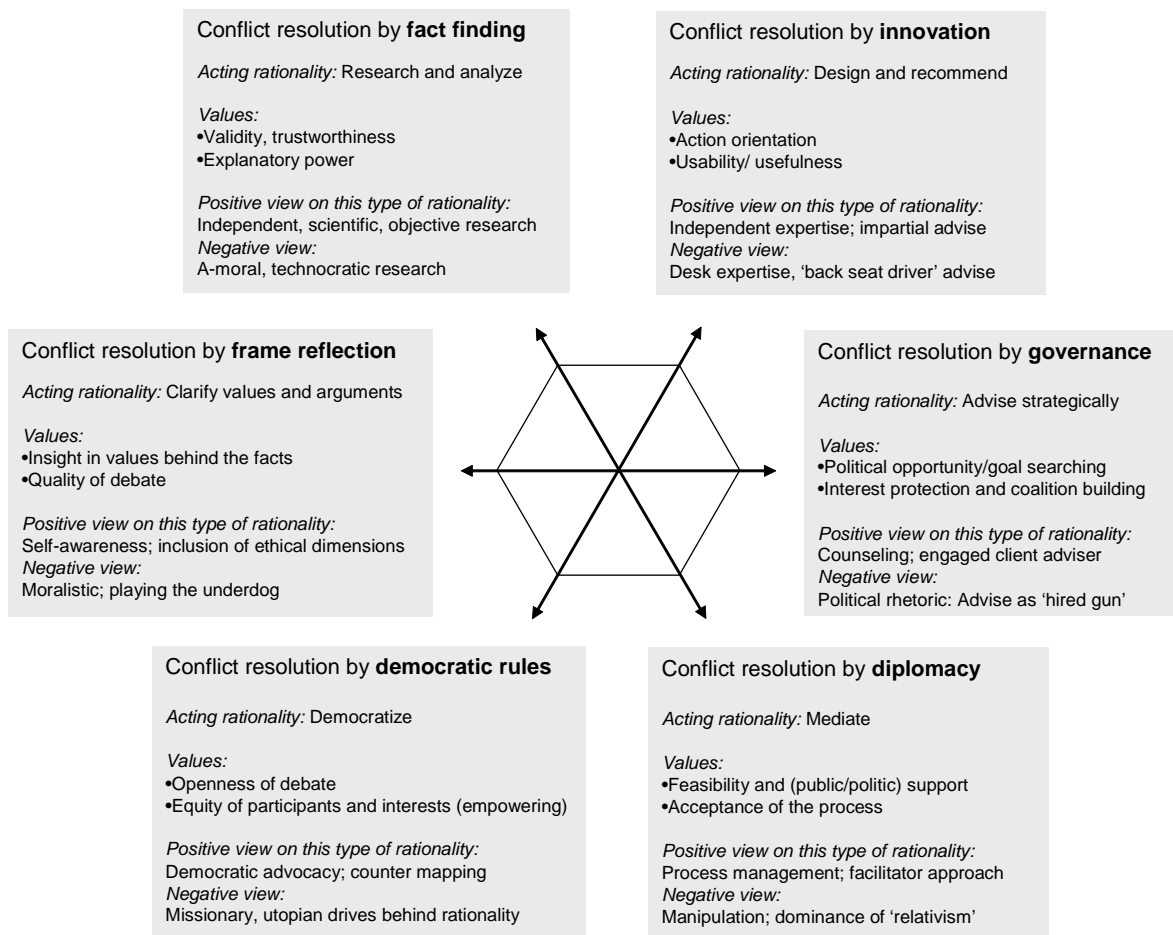


Figure 6. The hexagon model of Mayer et al (2004), adapting the perspectives as dimensions for conflict resolution.

The steps for using this model are the following:

Firstly, the practitioner can use the six dimensions like we did, in diagnosing the nature of the conflict.

Secondly, when the nature of a map controversy is identified as a clash between two or multiple of the six dimensions of Figure 6, then the remaining other perspective(s) can be explored on possible directions for conflict resolution. In other words, these other perspectives offer a base for a new framing of the issues at hand.

Thirdly, the new framing, accordingly, offers alternative grounds for strategies to intervene in the policymaking process and *change the role of the map*, in order to solve, prevent or overcome map controversies. The ten mechanisms that are enumerated in this paper can serve as concrete checklist of strategies that PGIS practitioners can either employ themselves or keep

in mind in order to recognize these moves of others.¹³ If one uses the mechanisms this way, keep in mind that the mechanisms do not need to be applied on the PGIS effort and map-making efforts as a whole, but they can be applied to controversial parts of the GIS activities and (-maps).

Meanwhile, with the described case studies we want to point to the importance of awareness about the tensions' "own logic" in processes. Tensions around maps have their own costs, benefits and added value. We are not saying that a practitioner should avoid every conflict and try to reframe the issues as soon as conflicts seem to emerge. As can be seen in the case example of the protected areas in French Polynesia, map conflicts can have their own functionality in clearing the human relationships between different groups who populate the same spaces; democracy is characterized by the embedding of normative *disagreement* in its institutional structure.¹⁴ But when policy processes have come to a hold and people are 'trapped' into a playing a game like chess that ends in a draw, rendering the actors immune for reasonable arguments, it may be time for intervention.

For ethical considerations of how a PGIS practitioner *should* choose and behave in employing these mechanisms, we refer to the Code of ethics for GIS professionals based on the work of Will Craig.¹⁵ We have shown some examples of mechanisms how maps *can* influence the framing process in policymaking, and vice versa, how the policymaking process affects the use of maps. We argue that with a conscious framing of policy issues and a considered role for the map, the PGIS practitioner can use the tensions inherent in maps for his/her benefit; purposefully increasing or releasing tension around his most important instrument.

6. Conclusions

We have enumerated in this paper a number of tensions inherent in map use and a number of strategies how was dealt with these tensions in practice. Maps serve different purposes at different times and in different occasions. Actors have different individual intentions in the process, hold different frames or worldviews and use different strategies to achieve their objectives. All these elements influence the use of maps and GIS (and models in general), and influence how actors perceive the role of maps in debate.

This paper addresses a number of deliberative mechanisms in policy discourses where GIS outcomes and/or maps have become controversial. We have focused on social mechanisms, as many case studies of PGIS suggest that 'the political complexities inherent in community participation may be larger obstacles for system implementation, and that technical challenges may be overestimated' (Craig et. al., 2002, p. 368).

Depending on the actor's diagnosis of the problem and their perspective on the policymaking process, the dynamics in the deliberations are framed in a certain dimension. In the cases we have seen, it was never unambiguously clear on beforehand which exact course of action would come out of a certain escalation of map tensions. But simultaneously, a number of directions could be phased out as not-likely and, in hindsight, the course that had finally taken shape was

¹³ On each of the six dimensions of the hexagon model, an extensive body of literature exists. For an overview, we refer to the literatures mentioned at the explanations of each of the six dimensions in Mayer et al (2004).

¹⁴ In democracies, disagreement in thinking is considered as basic human right. Disagreement also serves as necessary critical reflection of how the elite, being elected by a majority, rules over the whole of majorities and minorities.

¹⁵ Code of Ethics for GIS professionals: http://www.gisci.org/code_of_ethics.htm

often not a complete surprise. Thus, while we acknowledge that deterministic prediction of outcomes in conflict situations is impossible (let alone because the free will of participants to act irrationally) it is, in our view, possible to trace the constituted underlying structural dimensions of the conflict and accordingly, to diagnose which strategies for conflict resolution might be more fruitful than others. The structure of six perspectives in the hexagon model, with concurrent dimensions of conflict resolution, offers a handheld for rethinking map controversies.

By providing knowledge about concrete options how is dealt with map controversies in practice in five cases, we hope we have shown some examples of how one *can* cope with them. We hope this may serve as handheld in order for PGIS practitioners to be able to make their own conscious choice if they see themselves situated in a project where the maps have become, or are about to become sensitive, controversial or forbidden. Furthermore, we hope to contribute to the challenge set out by Craig et. al. (2002, p. 372) about how PGIS can contribute to more inclusive spatial decision-making.

Acknowledgements

The author wants to thank the researching colleagues of the Faculty Technology, Policy and Management, for much of this paper builds upon their work and school of thought: Igor Mayer, Els van Daalen and Pieter Bots for elaborating on their Hexagon model on policy analysis and Bert Enserink, Michel van Eeten, Sonja Karstens, and Guus Berkhout for their empirical analyses that served as secondary case material in this paper.

Appendix

Table 3. Collection of case studies where maps or GIS is used

Case study	Description and references
<i>Examples of the MAS research program of the Faculty Technology, Policy and Management, TU Delft</i>	
<ul style="list-style-type: none"> Water Opportunity Map Delfland 	This 'running case study' is based on direct observation of over 20 project meetings during two years and detailed analysis of arguments taken from the spoken and written deliberations and by interviewing the participants repeatedly after meetings (Carton, 2002a; Carton and Enserink, 2005; Van Eeten et al, 2002; Delfland, 2003 and 2004).
<ul style="list-style-type: none"> The "Game on Space" to simulate development planning in the city-network of Brabant 	This case study is executed in the form of a simulation game. Over 50 participants played the game about the development of a "new map" for the region Brabant, with the aim to constitute a 'network-city' out of five individual cities. The game was played twice, based on different future scenarios. With help of three instructed observers, the various kinds of map use and their consequences have been followed (Carton, de Jong et al., 2002).
<ul style="list-style-type: none"> Water Opportunity Maps in the Netherlands, comprising several case studies 	The similarities and differences between Water Opportunity Maps of different regions have been compared. (sources: Van Dijk, 2001; Carton and van Norel, 2002; Carton, 2002b)
<ul style="list-style-type: none"> The Green Heart Roundtables 	See description in this paper. (source: Van Eeten, 1999)
<ul style="list-style-type: none"> Planning of the High Speed Train Infrastructure through the city of Eden 	See description in this paper. (sources: Enserink and Monnikhof, 2000; Edelenbos, 2000;)

- Noise disturbance at Schiphol Airport See description in this paper. (sources: Central Planning Bureau (CPB), 2002; Berkhout, 2003; Wagenaar, 2003; http://www.milieudefensie.nl/verkeer/visie/schiphol/schiphol_2.htm http://www.evaluatieschiphol.nl/html/informatie_4.html)
- The Long Term Vision for the Scheld This case study about the deepening of the Scheld estuary is part of PhD research of Sonja Karstens and part of the European project “Harmonicop: Harmonising COllaborative Planning, Public Participation and the European Water Framework Directive” (sources: Enserink, Kamps and Mosterd, 2003; Karstens 2003; <http://www.harmonicop.info/>)
- ‘Integral Planning of the Veluwe Randmeren’ (IIVR), This case study was part of the LWI Programme on Land-, Water- and Environment related Infrastructure and Information. Several participative workshops with stakeholders and experts were organized in preparing a new policy on the lakes that have been constituted between new polder land (the Flevopolder) and ‘old’ land between 1996 and 2001. The GIS-tools and spatial visualizations contributed in the vision-building activities and deliberations of working groups (sources: LWI, 1997 and 1998; Van der Most, Koppenjan and Bots, 1998; <http://www.riza.nl/iivr>)
- National Policy Document on Spatial Planning in relation to the making of policy maps In 2004, a new national policy document on spatial planning appeared in the Netherlands: National Spatial Strategy. Creating Space for Development (VROM, 2004). It was constructed upon the preparation work of a previous government, whose ‘Fifth national policy document’ (VROM, 2001) had not been formalized by approval of the Lower House of Parliament. (sources: the National Spatial Strategy by VROM, 2004, available at <http://www2.vrom.nl/notaruimte/0101010000.html>; Dossier on the making of the Spatial Strategy by VROM on <http://www.vrom.nl/pagina.html?id=3410>; Commentary articles circulating in press and collected in the Archive on Dutch spatial planning news on www.ikcro.nl; Workshop on legends for national policy maps on January 30th 2003 at the Ministry of Housing, Spatial Planning and the Environment, reported in BNG (2003) De legenda van Nederland; interviews with two employees of the Dutch Ministry for Housing, Spatial Planning and the Environment (VROM) [Carton, unpublished])

Examples with advanced, institutionalized GIS tools in the Netherlands

- The New Map of the Netherlands The New Map (in Dutch: de Nieuwe Kaart) is an Internet-based GIS tool in which all spatial plans of the Netherlands are collected and displayed. The first version of the map was published in 1997, in analogue format; the GIS-based version was first presented in 2002. Today, the Ministry VROM carries responsibility of maintenance, the project bureau is located at the NIROV institute in The Hague. In the “Game on Space”, this tool has been ‘simulated’ by an analogous scale model, which was being updated continuously during the game. (sources: www.nieuwekaart.nl; regular email-newsletter of De Nieuwe Kaart van Nederland; Research Project ‘The New Map: considering possible usage when preparing spatial plans’ of the Netherlands Institute for Spatial Research; Carton, forthcoming)
- the Environment Explorer The Environment Explorer is a GIS analysis tool developed by RIVM, the National Institute of Public Health and the Environment and RIKZ, Research Institute for Knowledge Systems between

1997 and 2004. The instrument exists of an advanced DSS simulation-and visualization tool combining macro-economic models with micro-economic impact models that are projected on various map layers. The tool calculates and visualizes alternative scenarios on future land use. (sources: RIVM, 2001; <http://www.riks.nl/projects/LOV>; Van Delden, 2003)

International examples

- the P3DM method for GIS Participatory 3-Dimensional Modelling (P3DM) method has been adopted at several places worldwide to collect and communicate information about spatial issues with local communities. Implemented at The Philippines, Vietnam, India, Ecuador and Fiji (Rambaldi and Callosa-Tarr, 2000; <http://www.iapad.org/>).
- The ESDP process for European spatial planning European policy project to develop a transboundary spatial vision on Europe (sources: Ulled and Guevara, 1999; Faludi and Waterhout, 2001; Duhr, 2002)
- Appointing marine protected areas in French Polynesia See description in this paper. (Stonich, 2002; Walker, 2001a, 2001b, 2003)
http://www.csiss.org/events/conferences/2002/stonich_aaa.pdf
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