PARTICIPATORY INTEGRATED ASSESSMENT IN FIVE CASE STUDIES

REPORT OF WORKPACKAGE 4 OF THE FIRMA PROJECT

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Coordinator: Professor Nigel Gilbert, University of Surrey

Editor: Jörg Krywkow, Maasstricht University, ICIS

Email firma@soc.surrey.ac.uk
Project Home Page http://firma.cfpm.org/

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3. SUMMARY

This report summarises the results that have been achieved in work package 3 of the FIRMA project. As a result of regional differences, it was not possible to provide an overall prototype of a participatory approach that is applicable for all of the case studies. However, the report gives an overview of participatory approaches conducted in five regions that are distributed throughout the western part of Europe. It describes regional participatory settings, and the various endeavours to implement the guidelines of the Water Framework Directive in water management projects that involve institutional as well as individual stakeholders in decision making processes. One of the main features of this description is the conjunction of participatory methods with agent-based modelling techniques that are described in more depth in work package 3. The main components of the participatory processes in the regions are negotiation around common resource problems, co-operative decision making and the collaboration between lay people and experts. Bottom-up as well as top-down approaches have been applied, depending on the set of issues and problems within the particular river basin. Participation had several functions from problem identification to model building, model validation and decision making. The synergies between participation and agent-based modelling are described and will be analysed in more depth in work package 5. The work package 4 report can also be seen as feedback on how the Water Framework Directive can be implemented in regional cases, and what the advantages and pitfalls of these guidelines can be.

4. INTRODUCTION

Jörg Krywkow, ICIS

In the work package four (WP4) of the FIRMA project we will focus on the application of stakeholder participation in the five case studies. Whereas WP3 focuses on the exploration of what we can do with agent-based models (ABM), WP4 has to determine the feasibility of ABM in applied participatory processes, and how we can link Stakeholder participation with the modelling process per se. The integration of methods is of high importance, and will be described in WP5 in more detail.

The role of participatory methods within an Integrated Assessment framework became more significant within the last decade. This is because of an increasing number of research approaches, such as FIRMA, dealing with the interaction of social and natural systems on the one hand. More importantly, there has been a growing interest among decision makers and planners in gaining deeper insights into complex problems involving public participation in decision making and planning processes. Moreover, technical or so-called end-of-pipe solutions turned out to be quick solutions. However, over a longer period of time social or environmental conflicts resulting from these quick solutions became inevitable. Additionally, environmental awareness and a tendency toward democratisation among the public are increasing and can no longer be ignored by engineers and decision makers. Environmental problems are now recognised to be more complex and encompass environmental, economic and social dimensions. Above all, a high level of uncertainty and the lack of clearly defined cause-effect relationships require more sophisticated management methods. Water management is a typical example of this complexity. Sustainable water management strategies need to incorporate, for example, issues of climate change and land use change as impact variables on a catchment system on the one hand, and changing consumer behaviour, changes in economic growth and infrastructural measures, on the other. Recent flood events in Central and Southern Europe proved that flexible management strategies can significantly affect the amplitude of impact of extreme events on socio-economic values. In the case of floods, it is obvious that long-term planning and risk management strategies involving environmental as well as socio-economic boundary conditions are capable of dealing

with extreme events in a sustainable way. Ad hoc measures like short-term raising of dikes can only mitigate extreme peaks.

Those flood events also revealed various country-specific approaches to management problems with various levels of success. The European Water Framework Directive (WFD), however, provides European governments with guidelines for dealing with water-related problems. WFD requires public participation and encourages the active involvement of all interested parties in management plans. Furthermore, WFD introduces the river basin scale as an underlying management unit. The directive resulted from positive experiences in international large-scale river management projects such as IRMA/SPONGE (2000) for the Rhine basin. In addition to the spatial scale of the river basin, WFD (2000) proposes planning options over a period of six years. Given the consistent management framework demonstrated by the WFD this management directive can contribute to sustainable and democratic solutions in water management.

However, how can the ambitious and complex management requirements of the WFD be implemented in a suitable methodological framework? How is it possible to analyse environmental problems in conjunction with socio-economic boundary conditions at a suitable level of detail, and than to include the most relevant environmental and societal processes. Such an analysis method, e.g. a model, must incorporate both feedback loops and stakeholder interests and expert knowledge.

In response to the need of such a method Integrated Assessment was developed as a multidisciplinary method that integrates scientific knowledge such as hydrology and hydraulic engineering with lay knowledge, and makes it available for decision making processes the last decade. Integrated Assessment is defined as "... a multi- or inter-disciplinary process of structuring knowledge elements from various disciplines in such a manner that all relevant aspects of a social problem are considered in their mutual coherence for the benefit of decision making." (Rotmans, 1999, 2). In other words, Integrated Assessment strives for a framework to deal with complex problems from both environmental and socio-economic domains on the one hand, and moreover, endeavours to provide decision makers with insights and pre-processed knowledge to understand the complexity of a particular problem domain and draw suitable consequences. A closer look in the Integrated Assessment 'toolbox' reveals the core principle of combining analytical (modelling) methods with qualitative methods such as participative processes.

In one of the first Integrated Assessment models Hoekstra (1998) endeavoured to develop an integrated water balance model by applying cultural theory to illustrate the perspectives of water consumers and suppliers in order to investigate uncertainty in the field of water use at a world scale. Included in the water balance supply and demand have been incorporated from the point of view of various types of water users. The so-called 'cultural stereotypes' represent types in an almost exaggerated way. However, this approach already gives insights to the dynamics of water balance affected by anthropogenic water uptake, and seen from multiple perspectives. It also gives insights to the range of possible extreme as well as most likely volumes of water use under a variety of environmental boundary conditions. Within the FIRMA project researchers operate at a smaller scale level (catchment) where actors can be identified, and incorporated into a model by specifying their goals and interests. The fact that the FIRMA project wants to improve on existing integrated assessments by applying agent-based modelling is a step forward in integrating lay knowledge and expert knowledge on the one hand, and improving modelling techniques in an Integrated Assessment framework on the other. Hoekstra (1998) describes processes within a target system with the help of mathematical equations, whereas the actors in an agent-based approach are capable of executing processes (This can, of course, be done by mathematical expressions, but also by logical expressions or simple rules). The fact that computer agents are independent software entities, as opposed to centralised object-oriented software, allows for the modelling of behaviour that can be almost directly derived from real-life actors. Additionally, an approach on a regional scale permits for a thorough investigation of who the relevant actors or groups of actors are in the supposed target system. Because of its flexibility an agent-based model seems to be a promising approach for integrating stakeholder knowledge and behaviour into an analytical model within an integrated assessment framework. However, participatory methods are developing rapidly since political pressure demands more democratic and flexible solutions. This requires a very careful and conscious choice of a suitable method for a specific regional situation. What are the main issues within a river basin in a given period of time? Who is involved in the problems? Pahl-Wostl, (2002) defines two dimensions of participation to be identified and incorporated in a specific approach: the type of participation - stakeholder or public participation and the temporal stage of participation. To initiate this approach three steps are proposed: agenda setting - mapping out the diversity of arguments and opinions on the issue;

shaping the issue - developing a plan for resolving the issue and setting the goals of a participatory process; and implementation - compensation and conflict resolution play a significant role. The FIRMA approach is based upon five different regions containing at least five different issues as described in the WP2 documentation. In addition to issue identification, agenda setting and identifying the type of participation, a suitable participatory method has to be selected. The WP2 documentation demonstrated that the specific political situation and the culture and tradition of public political discussions, as well as the willingness to participate in a public discussion all play a significant role within a participatory set-up in each of the regions. Pahl-Wostl (2002) identified a number of participatory approaches that are widely used in environmental management: focus groups with citizens, planning cells and mediation as main methods. However, Pahl-Wostl (2002) postulates innovative approaches for participatory approaches, particularly with regard to creating interfaces with an agent-based model, and especially dealing with complex environmental problems. The WP2 document reports a number of processes such as technical innovations, change in consumption behaviour and emerging issues, such as infrequent extreme events, that might change the course of a management project, especially those projects striving for a sustainable solution within longer-term planning schedules.

In addition to dealing with social dynamics and environmental boundary conditions, an IA framework has to cope with a `new dimension' of integration. Participation has to be extended to enable a validation process for a proposed model. Stakeholders have to be involved in the modelling process to ensure their perspectives are represented adequately, and that the most relevant issues are incorporated in a model. This entails a process of social learning similar to those occurring in democratic decision-making processes. Both modellers and stakeholders have to be aware of the uncertainties resulting from the incorporation of the human dimension in a modelling process.

4.1 A Brief Introduction to the Five Case Studies

4.1.1 Barcelona

The most important objective of this case study is the discussion of domestic water management alternatives through stakeholder participation. In the last decade water demand has been driven by suburbanisation processes within the Metropolitan Region of Barcelona. The problem of seasonal water scarcity aggravated this problem. The

FIRMA team in Barcelona created a complete new stakeholder platform involving governmental and non-governmental organisations, water suppliers and consumer organisations. This has never been done before in this region. Based on a questionnaire three scenarios of future trends of the domestic water sector in the study area have been developed, and discussed within the stakeholder platform.

4.1.2 Maastricht

The Maastricht case study focuses on a combination of issues (safety, gravel extraction and nature development) resulting from a planning procedure that proposes to change the morphology of the river section of the Maas in Limburg, The Netherlands. A stakeholder platform was established several years ago by the project organisation 'Maaswerken'.

The FIRMA team in Maastricht is investigating the dynamics of stakeholder interaction within that planning process, and is attempting to propose alternative planning strategies, including stakeholder perspectives and uncertainties arising from climate change as well as land use change scenarios. The greatest challenges are the long-term planning procedure and the complexity of the problems within that case study.

4.1.3 Orb

The Cemagref FIRMA team has been chosen a river basin in the South of France. The objective is to support the regional river management organisation in a concerted water management project involving stakeholders such as water users (households, agriculture and tourism), water suppliers and basin managers. The purpose of this support is to provide stakeholders with methods for analysing their actions and to facilitate communication between actors. It takes place in the context of tool development to enforce the French 1992 water law and the new European WFD.

In this case study, models and computers are seen as communication tools in the negotiation / discussion process. The Cemagref team works in two directions:

First, participants have to be convinced to apply the models as a basis for supporting the dialogue and simulate scenarios. Second, the decision making approach of the participatory process is observed and supported.

4.1.4 Thames

The main issues of the Thames case study are domestic water demand and drought management. These two examinations have required different problem specifications and agent descriptions. The purpose of the investigation of domestic water demand in the FIRMA project is to improve demand planning and management by using agent-based modelling to explore behavioural factors and dynamics that may be at play in domestic water consumption. The participatory process in this region involved governmental organisations, water managers and non-governmental nature organisations. The role of the modelling in this participatory process was to demonstrate the potential for alternative explanations of patterns in aggregate demand.

4.1.5 Zürich

In the Zürich case study, the FIRMA team had to deal with the central problem of oversupply of water. For many households, water saving measures in conjunction with higher prices are difficult to understand. The actors' platform, created by the FIRMA team, included city representatives of the water utility, the wastewater utility, a manufacturer of water using technologies, the architects association, the plumbers association, the consumers association, the association for water and gas utilities, and a local politician. A number of innovative participatory approaches like role playing games and hexagon methods have been applied to increase mutual understanding in the context of co-operative decision making. Participatory model building was a central activity.

4.2 Summary

One of the ambitious goals of the FIRMA project was to find a generic approach to participation similar to the endeavour to find a generic ABM. In this document we describe regional participatory approaches in depth. The regional studies may also be seen as field test of how the European Water Directive can be translated into specific regional applications, and how well these guidelines have been applied in conjunction with innovative methods within an integrative methodological framework. Finally, we compare and summarise the results including all the lessons learned from these case studies and give some indication of further projects that could build on these results.

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5. STAKEHOLDERS AND PARTICIPATORY METHODS IN THE BARCELONA CASE STUDY

Mercè Capellades, Mònica Rivera, David Saurí; Universitat Autonoma de Barcelona

5.1 Introduction

The water cycle in the Metropolitan Region of Barcelona (MRB) follows a typical Mediterranean pattern: Long, dry periods during the summer season but extending also throughout the year, and short, heavy rainfall episodes in autumn and spring producing important flash flood episodes. Thus climate constrains water availability in the MRB in important ways despite efforts in increasing the quantity of regulated water through reservoirs in the Llobregat river, and the transfer from the Ter river. At the end of the 1990s, the average balance between water supply and water demand was in equilibrium but a succesion of dry years has stressed the system to the point that new management alternatives (be these the increase of supply via conventional or alternative means or the reduction of demand via water conservation) need to be explored (see our contribution to WP2).

The discussion of domestic water management alternatives through stakeholder participation is the most important objective in our case study. In order to accomplish this objective it was necessary to create a stakeholder platform that incorporated the maximum number of views on the domestic water sector, and to select the participatory methods most suited to extract stakeholders goals, preferences and attitudes towards domestic water. This report is intended to present the main issues involved in the participatory process, and it is organised as follows. First, we justify the selection of stakeholders on the basis of interest and involvement in the management of domestic water in the MRB. Second, we attempt to elucidate the most important characteristics of our stakeholder platform, including a description of each participant in terms of a) his / her role in the management of the water cycle in the MRB; b) his / her management priorities, and c) the willingness to collaborate with the FIRMA project. Third, we describe the processes and methods of participation, consisting in individual and group meetings centered upon two key items: the

development of scenarios on future trends of the domestic water sector in the study area, and the elaboration of an agent-based model able to capture the most salient characteristics of these scenarios in terms of the balance between water supply and water demand. Fourth, we identify the main issues appearing in the discussion of initial versions of the model with the stakeholder platform, which are then used to profile the main contours of the final model. The process thus described was partially completed in the final meeting with the stakeholder platform that took place in January 2003.

5.2 Justification for the selection of the stakeholder platform

Our study area belongs to the so-called "Inner Basins of Catalonia", a hydrographic unit comprising several river basins in the Northeast of Spain the management of which lies in the Catalan Water Agency (ACA), of the Catalan Department of the Environment. The ACA is therefore the most important public authority in matters regarding water in the MRB and plays a fundamental role in deciding policy alternatives, although some of these alternatives have to be in accordance with Spanish law and with regulations emanating from the Spanish Ministry of the Environment.

The responsibility of supplying water to urban consumers belongs to two separate bodies. What we call "primary distribution" (that is, water management in reservoirs and in regional distribution networks up to the delivery points of each municipality) is performed by the public company "Aigües Ter-Llobregat" (ATLL). Water supply within each municipality to the final consumer may be either under the hands of the city councils through municipal water supply companies or, more and more common in the MRB, in the hands of private companies to which city councils have transferred management in exchange for an annual fee. In our case, the most important of such private companies is "Aigües de Barcelona" (AGBAR). Together with some subsidiaries, the AGBAR group currently controls about two thirds of urban water supply in the MRB.

Water demand has been influenced in the last decade by changes in the spatial distribution of the population within the MRB and, more importantly, by changes in

the housing typology. Thus the traditional Mediterranean compact urban form (high population and housing densities) is giving way to a more Anglo-saxon-like diffuse urban form (low population and housing densities). This process has important repercussions in the patterns of water consumption because of new indoor and especially outdoor uses (gardens, swimming pools, etc.). Water consumed in the "compact city" reaches about 125 liters/capita/day (lcd) whereas water consumed in the "diffuse city" escalates to 165 lcd or to more than 300 lcd in certain cases. The importance of housing trends and of the housing market in these patterns justifies in our view the need of incorporating the "Associació de Promotors i Constructors Inmobiliaris" (Association of Real Estate Developers and Builders, APCE) into our stakeholder platform. Likewise, the importance given to domestic water saving technologies in most of water demand strategies advised us to invite "Roca Radiadores", the largest company producing such devices in Spain.

Urban community groups and consumer groups have also played a significant role in shaping water policy in the MRB. The "Confederació d'Associacions de Veïns de Catalunya" (CONFAVC), an association of neighbour community groups, led the struggle against what they considered excessive water taxation in Barcelona during the 1990s and successfully negotiated with the ACA a new tax system for water in Catalonia. The "Organització de Consumidors i Usuaris de Catalunya" (OCUC) pools consumer complaints about the quantity, quality and price of water and gives therefore a view from the consumer end. Finally, "Alternativa Verda" (AV) is the green political party that has shown a greater interest in water management and conservation.

5.3 Stakeholder description

Originally, our stakeholder platform is composed by two public entities (ACA and ATLL); three private organisations (AGBAR, ASAC, APCE and Roca), and three civic groups (CONFAVC, OCUC and AV). At the beginning of the process, ASAC withdrew from the platform due to preoccupation with other tasks. It is important to stress that no platform of this kind has been formed previously to examine water issues in the region (although some of its members belong to the Water Council of Catalonia, an advisory body to the ACA). Thus, our participatory process represents a

novelty with all the advantages and drawbacks that this implies. Advantages because we believe we have incorporated voices that have a lot to contribute to the water debate, and have nor been heard so far (cases for instance of APCE or Roca). And drawbacks because the lack of experience in this kind of iterative dialogue, and because some of the stakeholders (APCE, for instance, and also the Association of Hotel Owners and Managers, finally not included) did not clearly see their role in such a platform.

Stakeholders have been divided as follows: public organizations (black); private companies (blue) and civil society (green).

Table 5.1: Types of Stakeholders

	Decision maker	***Executor***	***Influencer***
Metropolitan Region of Barcelona	**ACA** (Catalan water agency)	**ATLL** (Water supply network manager) AGBAR (Water supplier company)	ROCA (Manufacturer of domestic water technology) APCE (Association of builders and real estate developers) CONFAVC (Confederation of neighborhood community OCUC ALTERNATIVA VERDA (green political party)

5.3.1 Public Organizations

5.3.1.1 ACA (Agència Catalana de l'Aigua)

5.3.1.1.1 Role in the hydrological cycle

ACA was created in 1999 by the law of Water Planning, Management and Taxation of Catalonia (Law 6/1999 of the Parliament of Catalonia). It reflects the purpose of the regional government to concentrating all water-related issues in a single regulatory body under the authority of the Catalan Department of the Environment.
Funds for the implementation of water policies by the ACA are largely obtained through the application of the so-called "Water Tax". This new tax substitutes the highly fragmented and confusing array of previous taxes on water.

5.3.1.1.2 Special considerations (Priority)

The most significant activity of the ACA is the planning and execution of water supply, flood control, and wastewater treatment infrastructure. The ACA has also regulatory powers in determining the occupancy of flood-prone land; setting and enforcing the standards for water quality, and setting water taxes. It is also responsible for establishing user priorities in the case of drought and of educational campaigns for water conservation.

5.3.1.1.3 Interest in FIRMA

This is a very new regulatory body. Personnel coming from other governmental departments may be still attempting to consolidate their positions of power and influence.
There is not much tradition of working with universities in research projects

5.3.2.1 ATLL (Aigües Ter-Llobregat)

5.3.2.1.1 Role in the hydrological cycle

ATLL is a public company in charge of the primary water supply network in most of the Barcelona Metropolitan Region. ATLL services 128 municipalities with water coming from two main systems: The Ter-Cardedeu transfer, and the Llobregat-Abrera system. The main responsibilities of ATLL are the management of water permits for public supply and the operation, maintenance and enhancement of the primary water network in the Barcelona region.

5.3.2.1.2 Special considerations (Priority)

It has been very active in supporting the plan to bring water from the Rhone river in France to Barcelona whereas they remain very sceptical about the proposed transfer from the Ebro river which is supported by the Spanish National government.

5.3.2.1.3 Interest in FIRMA

Their main interest is the opportunity to confirm their scenarios about increasing water supply problems in the Barcelona region over the next decade. They have been very supportive in terms of providing data and time of their experts. They have even showed some interest in partially financing studies that are of interest for FIRMA, such as the survey on water consumption behaviour of families.

5.3.2 Private companies

5.3.2.1 AGBAR (Aigües de Barcelona - Societat General d'Aigües de Barcelona)

5.3.2.1.1 Role in the hydrological cycle

AGBAR is the most important private water company in the study area. It directly serves Barcelona and 22 other municipalities. The AGBAR holding encompasses another water company, SOREA, that serves an increasing number of municipalities

in the region. Their primary networks distribute water coming from the regional networks operated by ATLL and also from the river-aquifer system of the lower Llobregat owned and operated by AGBAR (total resources: 250 cubic meters/year, and serving some 3 million people).

5.3.2.1.2 Special considerations (Priority)

Their perception is that, for instance, water saving policies have a limited impact in Barcelona. They support conservation policies through the application of water-saving technology.

5.3.2.1.3 Interest in FIRMA

The company collaborates with FIRMA through the AGBAR Foundation, their research branch created in 1998. Their position about the FIRMA project has been somewhat one of caution: they have shown interest in the project, particularly with the approach of "integrated resource planning and management". AGBAR does not wish to appear too visible in the debate about the future of the water cycle in the region, especially when deciding about alternative sources of extra supplies.

5.3.2.2 ROCA

5.3.2.2.1 Role in the hydrological cycle

It is family-owned, it was created in 1917, and it currently owns factories in Spain and in four other countries, and sells its products in more than fifty countries around the world. Roca is the leading manufacturer of domestic water technology in Spain, particularly toilets, taps, bathtubs and showers. The R&D efforts put into water-saving technologies were recognised by the regional government through a certification of "Environmental Excellence" in December 2000.

5.3.2.2.2 Special considerations (Priority)

The lack of public attention to savings in mains and other elements of the general water installation in buildings. The labyrinth-like and sometimes contradictory

structure of European, Spanish, and Catalan norms concerning flows from taps and showers. The impact of water quality (for instance, sulphate concentrations) on domestic piping systems. Further savings are possible in the domestic sector but, the most important emphasis should be put in agriculture which by far and large is the greater consumer of water in Spain (although not in our study area).

5.3.2.2.3 Interest in FIRMA

•Roca has shown interest in the project.

5.3.2.3 APCE (Associació de Promotors i Constructors d'edificis)

5.3.2.3.1 Role in the hydrological cycle

This association (created in 1970) represents the interests of the main builders and real estate developers of the Barcelona area. Rapidly expanding housing sector in the region, often with gardens and pools.

5.3.2.3.2 Special considerations (Priority)

Water issues do not appear to be especially relevant for APCE. They tend to be included under the more general environmental concerns, and, in these, they display limited interest when compared to other aspects (for instance, energy efficiency). Housing trends and perspectives of future urban growth in the region. It has organised several seminars for its members on "sustainable building", none of them, specifically, addressed to water conservation. The fifty or so information bulletins for associates issued in 1999, only one had water as a central theme, and just to inform about new tariff structures.

5.3.2.3.3 Interest in FIRMA

When approached to present the FIRMA project, and ask for collaboration, the representatives of APCE manifested that they found it "interesting", but they ignored how they could contribute.

5.3.3 General Public

5.3.3.1 CONFAVC (Confederació d'Associacions de Veïns de Catalunya)

5.3.3.1.1 Role in the hydrological cycle

It is a confederation of neighbourhood community groups in Catalonia that has played a key role in the so-called "water war" that affected Barcelona during the 1990s. The very creation of the ACA and the reorganisation of water taxes, finally accepted by the CONFAVC (although not by the entire membership), thus represent a successful intervention in the public policy arena. The group is now member of the "Council for the Sustainable Use of Water" of the ACA where it seeks alliances with the consumer and green groups.

5.3.3.1.2 Special considerations (Priority)

They are reluctant to accept the supposed water deficit of the metropolitan region, and they defend the quantity of 100 litres/capita/day as the basic consumption figure (below the current consumption levels in the city of Barcelona, already below European average). In accordance with several green groups, they oppose water transfers (and the likely increase in pricing that would imply) since less costly alternatives can be applied.

5.3.3.1.3 Interest in FIRMA

They have also shown interest in the FIRMA project although they made clear to us that their position on the water debate in Barcelona is already established.

5.3.3.2 OCUC (Organització de consumidors i usuaris de Catalunya)

5.3.3.2.1 Role in the hydrological cycle

The OCUC was created in 1979 with the objective of informing, advising and protecting consumer's rights as well as promoting sustainable and responsible consumption practices, It is the main association of consumers in the Barcelona area

with a membership of about 8,000. It is represented in the Council for Sustainable Water of the ACA. The OCUC became involved in the initial stages of the "Water war" but withdrew from the campaign due to disagreement with the confrontational tactics used by neighbourhood community groups.

5.3.3.2.2 Special considerations (Priority)

The effects of the pricing structure on consumers. They claim to have many calls received, protesting against the rise of water bills after the new tariff structure implemented by the ACA, especially about the limited water quantity included in the first consumption block of the bill (6 cubic meters/household/month). The chronic problem of drinking water quality in Barcelona (although this quality tends to vary spatially within the city and the suburbs). The frequency of these types of complaints has not so much diminished because of improvements, but because of resignation about what is perceived as an intractable problem.

5.3.3.2.3 Interest in FIRMA

•Participation in the FIRMA project has been hampered by changes in the contact person. After two unsuccesful attempts, we still have to find a valid speaker. But there is interest in FIRMA.

5.3.3.3 Alternativa Verda

5.3.3.3.1 Role in the hydrological cycle

This is a green political party founded in the early 1980s with the objective of promoting a sustainable production and consumption culture among the Catalan public. Alternativa Verda sought to improve the environmental performance of the city, especially in the areas of energy and solid waste. As in the case of other stakeholders, water is an issue of interest, but at least implicitly appears to be secondary to other more pressing matters.

5.3.3.3.2 Special considerations (Priority)

Alternativa Verda defends the common discourse among environmental groups of opposition to new water developments, and instead, the promotion of sustainable practice such as conservation, efficiency and recycling. They are especially critical of the environmental costs of the diffuse urbanisation process currently being experienced by the Barcelona region. They were opposed to new forms of leisure that are highly consumptive of water such as golf courses that are now proliferating in the region.

5.3.3.3.3 Interest in FIRMA

They were eager to collaborate with the FIRMA project as another forum for expressing their views on the water issue. Our main contact is a university professor who has participated in several European research projects, and who is aware of the potential result of our study. An interest in the project lies in the possibility of corroborating their position in water.

5.5 Process and Methods of Participation

Our approach to understanding domestic water management issues as reflected in the stakeholder platform began with an assessment of the views, preferences and the objectives of the different participants as well as of their relative influence in the decision making process. This assessment was obtained through two types of interviews. During the first six months of the project, we interviewed each stakeholder in order to present our study, and to gather information about their role and influence in water management in the MRB. The second round of interviews had a more specific purpose: develop a number of scenarios for water demand in the study area according to the opinions given by stakeholders. We prepared a number of propositions regarding the likely evolution of key parameters in the water cycle as well as the feasibility of different management options for the study area, and asked each participant to give their opinion on these propositions (see report on scenario development). The results of the questionnaire were used to develop three scenarios: one for high water demand; one for medium water demand, and one for low water demand.

Scenarios were subsequently tested in front of the stakeholder platform during two meetings, the first in January 2002, and the second in April 2002. The first was attended by members of ACA and AGBAR, while the second included members of ATLL, CONFAVC, Roca and OCUC. APCE, ASAC and AV did not attend the first two meetings, although they answered the questionnaire. Each session took half a day, and was organised as follows: First, we presented a brief summary of the scenarios developed and answered specific questions from the platform; second, we presented the main characteristics of the preliminary model on domestic water demand developed from the scenarios, and third, and with the help of an expert moderator, we discussed the main issues in the model with all participants.

5.5 Main issues appearing and ways to proceed

From individual interviews and, especially, from the two common meetings carried out with our stakeholder platform we have been able to identify the most important conflicting matters, namely:

-Water supply or water demand management (or a combination of both)

-Building a large scale water transfer to the MRB

-Enhance the use of treated wastewater at the household level, and of rainwater in multiple or single housing

-The varying impact of pricing in high income and low income households

-The impact on consumers of new water infrastructures via higher prices

-The building of desalinisation plants

-The impact of diffuse urbanisation in domestic water demand

Our presentation of the scenarios and of the very rudimentary model served us to gain knowledge about stakeholder expectations. Most important of these expectations was to obtain some simulated quantitative value of domestic water demand for the future, and the means to arrive at this value (i.e. a water transfer, demand management, desalted water, etc.). The expectations manifested by the stakeholder platform made necessary to redesign the model as to attempt to fulfil these expectations (see our contribution to WP3).

The model was presented at the platform meeting in December 2002. The way we conducted this final meeting was as follows. First, we distributed a working report containing a comparison between water demand forecasting performed with conventional methods (based on population increase and per capita water increase), and our agent-based model. The objective was not to offer the model as an alternative to conventional forecasting, but rather present it as a complementary tool that may capture important details not included in forecasting (i.e. simulate water demand according to various scenarios). This comparison served as the starting point for the December meeting. Stakeholders have been then asked to react on the results of the comparison in order to validate the model, and with the help of an expert moderator, discuss the appropriateness of the ABM model for the domestic water sector in the MRB.

5.6 Conclusion: Methodological lessons learned

Our participatory approach was designed according to two main issues. First, the highly conflicting nature of water management, and the nature of its various alternatives in the Metropolitan region of Barcelona, and second, the lack of tradition in participatory matters as well as the lack of previous involvement of, in our opinion, some important stakeholders. Thus we decided to begin with separate individual interviews, and introduce group meetings afterwards. This approach has proven useful in that it allowed us to build confidence in the process. It also allowed stakeholders to have already a familiarity with the objectives and methods of our research before the first group meeting.

The scenario exercise stimulated interests among stakeholders since it was based on their knowledge and experience. However, we were not able to produce a working model until after the second meeting and this perhaps lowered the expectations of the stakeholders. Furthermore, the results they were seeking (i.e. a quantitative estimation of future water demand and the most appropriate means to achieve this estimation) looked very similar to a simple forecasting. Some wanted a figure that proved current water demand forecasting, while others wanted the reverse. Hence, our final decision to build our simulation model, and then compare its results with those of forecasting. However, if we have learned something in the participatory process, this is that the

model to be developed could not simply be another general forecasting exercise but a tool allowing us to simulate water demand under different circumstances, and under different patterns of behaviour, most notably the differences in consumption observed between the compact and the diffuse urban forms.

6. PARTICIPATORY PROCESSES IN THE CASE STUDY OF THE MAASWERKEN PROJECT

Jörg Krywkow, ICIS

6.1 Introduction

The Maaswerken case study is characterised by its complex nature. This fact is already discussed in the WP2 documentation, which describes the nature of the planning procedure, the objectives of the planning process and types of stakeholders and the uncertainties that can be derived from environmental properties, various stakeholder perspectives and methodological limitations. Additionally, this document includes information about the negotiation capability of stakeholders and their level of representation, as well as conceptual modelling approach. The notion of complexity in relation to the Maaswerken case study can be described in terms of several dimensions.

1. Problem-related: There are three main issues to address, and these are all inter-linked.
2. Spatially: The region, the river basin of the Maas in Limburg, includes various local river sections requiring specific solutions.
3. Temporal: The planning procedure has been continuing for more then ten years. This resulted in the emergence of new issues, the emergence or disappearance of stakeholders, changing environmental conditions like run-off patterns, changing societal demand for problem solutions and random events like severe inundations.
4. Institutional: As reported in WP2, stakeholders have multiple interests, perspectives, and preferences. They have various modes of organisation and different means of influencing a negotiation process.

The participatory process in this case study consists of two parts: Participation organised by the Maaswerken and participation organised by the FIRMA research group in Maastricht. These two parts are also the main issues of the case description which follows. It also describes how the FIRMA approach builds upon the Maaswerken negotiation process.

6.2 Some facts about water management in The Netherlands

Water management has a long, democratic tradition in the Netherlands. It often serves as an example of a country with a well-structured set of institutions dealing with water related problems. Also, the involvement of the people in decision making processes exists longer than in most other countries in the world. Given the geographical situation of The Netherlands, and a long history of catastrophes as well as land-reclamation activities, a high level of competence in water management has been established over years. However, this long tradition resulted a hierarchical structure of management with often pre-processed solutions in form of standards based upon engineering experience and technical achievements. In other words, priorities and solutions were often given presented by water management experts and engineers before a public or stakeholder discussion could take place. This was an efficient and successful problem approach for years until societal changes, especially in the post-war period, led to a higher diversity, more knowledge and more individualism within the society. A first significant step towards more adaptive water management was made during the discussion about the Deltawerken (De Delatwerken) project (1954 – 1991). The long duration of that project is a reflection of two facts: it was the largest infrastructural project the Netherlands ever embarked upon, and previous plans had to be changed under public influence. The most impressive part of the Deltawerken project is the Oosterschelde dike. These huge flood protection facilities enable protection from severe maritime storm floods when closed, but also doe not disturb the water exchange of the river mouth when opened. The latter is important for the fishery and the unique natural habitat in the Oosterschelde river mouth. This project introduced two new aaspects of water management adaptive planning and public promotion of perspectives and interests.

6.3 The Maaswerken participatory process

Rijkswaterstaat, the body that oversees all water management in The Netherlands as well as the province of Limburg learned from the experiences of the Deltawerken and involved public interests at an early stage of the planning procedure. Moreover, a process of diffusion over years was shaped during the planning process. During the 1980s public awareness of nature protection increased and was more valued among citizens in The Netherlands. This phenomenon of public awareness was at that time

reflected in a concrete plan 'Groen voor Grind' (Green for Gravel) (Stroming, 1991). The development and protection of nature areas entered the first plan to develop the Grensmaas (the Southern section of the Maas in Limburg), even before the Maaswerken organisation was founded.
The second main issue of the planning process was gravel extraction. Every province in the Netherlands is legally required to deliver a certain amount of building material to the federal government for infrastructural projects. Green for Gravel is an attempt to create a win-win situation (extracting gravel and developing nature).
Random events can change the course as well as the content of a planning procedure. The inundations in 1993 and 1995 brought a new issue into the planning: safety. On the one hand the decision makers, especially Rijkswaterstaat, had to find a quick solution for flood protection. This was realised in 1995 with the so-called 'Deltaplan Grote Rivieren' (1995) (protection plan for large rivers). However, a sustainable and integrative large-scale infrastructure project can not neglect those events. This raises the question of why the issue of inundation was neglected so far? Catastrophes are a topic of discussion among people, and issues of concern among some institutions when they happen. The relevance curve or level of concern declines considerably, after a number of years remarkably until this issue disappears from the general awareness. The last damaging inundation in the Maas catchment was 1923!

In addition to the Grensmaas project another large infrastructural project, 'Zandmaas/Maasroute', (Maaswerken, 1999) was in the planning stage in the late 1990s. The main issues of this project are sand extraction and the improvement of the navigation infrastructure of the Maas in Limburg. The latter issue was triggered by the efforts of the Dutch government to minimise the CO_2 production largely by displacing the transport of heavy cargo from the road to water. Therefore, a suitable infrastructure must be provided.

In 1997, the integrative project Maaswerken (De Maaswerken) was founded by two governmental organisations: Rijkswaterstaat and the province of Limburg. The aim was to integrate two spatially adjacent or even overlapping projects for the sake of a more efficient planning and execution procedure. The foundation of Maaswerken was also formed in response to increasing challenges based on the complexity of the environmental and societal problems.

At this point the policymakers have already demonstrated the ability to respond to emerging problems and increasing complexity, and, in a way, the emergence of the Maaswerken project/organisation can be seen as a significant step towards adaptive water management. Moreover, the establishment of the Maaswerken organisation improved communication between experts, policy makers and stakeholders.

6.3.1 Public participation conducted by Maaswerken

The participatory process of the Maaswerken project has a common and legally-determined structure. The policymaker responds to societal and environmental requirements, and establishes the profile as well as the aims of a project. Experts, usually consulting companies or governmental scientists and technicians specify the plans, and open them up for public discussion. In other words, the Maaswerken project clearly uses a top-down approach. Usually, large infrastructural projects have to be justified through an environmental assessment conducted by a third independent body.

This all happened in the case of the Maaswerken. Moreover, not just one plan has been created, but a whole number of plans as described in WP2. This indicates the adaptive character of the planning approach on, but also reflects the problems of long-term planning procedures. The planning costs are, of course increasing with longer planning periods. The Maaswerken organisation is, thus, in a dilemma between flexibility and economic constraints.

In addition to the regular public participation, Maaswerken organised a wide-spread information campaign, utilising all available media. Telephone surveys also have been carried out to explore public opinion on the Maaswerken project. All of the medial-related endeavours and the corresponding responses have been documented (e.g. the so-called 'Knipselkrant' (Maaswerken, 2000) where all press releases have been documented and republished). The web side (www.maaswerken.nl) keeps the public informed about most recent developments. The Maaswerken organisation, including the supporting governmental institutions, are well aware of the impact of the media and public opinion.

An important tool of public participation was the establishment of regular group meetings, where recent problems have been discussed. New insights and results of

these discussions where implemented in the official plans. One of the most remarkable results is that side effects of the gravel extraction such as noise, air pollution and mechanic vibrations caused by trucks and heavy dredging machines (hinder) are estimated and implemented in the execution plan. This was only possible due to the impact of citizen groups based near the extraction sides.

The emergence of new issues in the planning process can be an indicator of influence of particular stakeholders or groups of stakeholders within the planning procedure. A single citizen or even a single village has relatively small impact on the planning process for a project on a regional scale. Thus, only until a coalition of several villages with the same goal has been formed, their concerns have the chance to be implemented in the plan.
Another coalition was formed within the affected region of the Maas bringing together gravel extraction companies and nature organisations. Their co-operation ultimately determined the quantity of gravel to be extracted as well as the size of the nature areas to be developed. In 2002, the gravel extractors suddenly decided to double the amount of gravel to be extracted with the rationale of achieving a cost – benefit balance. The reaction of the nature organisation was to resign from the co-operation, because a higher amount of extracted gravel would lead to morphological conditions that do not permit the development of most of the planned natural habitats. The problem was solved two years later due to a compromising solution put forward by the province of Limburg.

6.3.2 Stakeholder participation by the Maaswerken

The Maaswerken participatory process was as complex as the entire planning procedure. In fact, a clear and distinct development from public participation to stakeholder participation with the formation of a (semi) stable stakeholder platform was scarcely possible. Issues and interest groups changed relatively often over the planning period because of frequently changing plans over years with legally required public participation. Changing plans implies the change of measures or at least the magnitude of measures.
However, a core group of stakeholders remained within the negotiation process, where the stakeholders are seen as organisations represented by one person or a group

of persons. These are: the policymaker, the Maaswerken project group, the gravel extractors, the farmer association, the municipalities, the nature organisations, and a fluctuating number of citizen groups. Process-wise, participation continued in two ways: group meetings, where all stakeholders were invited, and current or most urgent problems were debated, and bilateral meetings (stakeholder – Maaswerken), where specific problems have been discussed. Moreover, planning co-operation has been established, e.g. between Maaswerken and the nature organisation 'Natuur Monumenten'. The representatives of the nature organisation have consulted Maaswerken experts in regard to environmental conditions for the establishment of natural habitats on an ongoing basis.

The extent, the variability, and the multi-problem character of the project made it more difficult for citizens and even experts to understand. For example, in 1999 Maaswerken decided to change the mathematical model and thus the software for the calculation of hydraulic properties of the riverbed. This was possible due to new computer technology and capacity that were able to handle more complex models than before. More specifically, the program was able to calculate stream velocities more thoroughly than the previous used program. That resulted in new values for inundation probabilities, and thus, for flood protection measures. This technological change with all its consequences is easy to understand for experts, but difficult for non-experts. Why do we need higher dikes? Because of the application of a new computer program that indicates this need? More importantly, it was hard to justify an extension of the planning procedure because of the introduction of new mathematical calculations. At this point, the planning costs have already exceeded the original assumptions.

Summarising, it can be said that an adaptive participatory planning approach has the advantage of:

- incorporating problems that have not been recognised beforehand,
- locating and taking advantage of expertise from third parties,
- creating and maintaining communication between stakeholders even with conflicting interests,
- and, thus, preventing conflicts that arise due to the consequences of planned measures.

- However, there are some disadvantages resulting from the complexity of the entire project:
- Higher scale measures have impact on lower scale facilities and infrastructure (this is often difficult to understand for involved stakeholder with lower-scale interests).
- The long planning period included changes in context and magnitude of the measures. Random events, and technological changes may lead to changing perspectives or even problems in understanding the urgency of incorporating new problems.
- The complexity of the planning endeavour makes it difficult for all stakeholders to deal with causal chains, multiple perspectives, and factors external to the project.

6.4 The FIRMA participatory approach

The participatory approach of the FIRMA team in Maastricht is based upon the Maaswerken approach. There is an enormous amount of information available. The objective is not to establish a new stakeholder platform, but to analyse the ongoing process, and to propose possible solutions to problems that have emerged by applying a combination of participatory integrated assessment and agent-based modelling. Therefore, available data have been analysed, and the most relevant stakeholders have been identified. In a later stage, most of the stakeholders were interviewed in order to retrieve supplemental information, and to elicit their mental models of the project.
The challenge for the Maastricht team is to apply IA-ABM methods in a way that enables improvements or alternative solutions of the current planning process of the Maaswerken project, and finding an approa to deal with the complex character of the project. The participatory part of this approach is to provide social data for the combined IAM-ABM, and to validate a prototype model.

6.4.1 Interviews

Two types of interviews have been conducted. The first type is informal meetings with Maaswerken experts. During these interviews information was gathered concerning the methodology of the Maaswerken project. As a result we received

much physical data, pre-processed GIS-data, and information about hydrological and hydraulic models. For this reason an official co-operation contract between the Maaswerken organisation and ICIS was signed in 2000. In exchange for delivered data and models, the ICIS team provides the Maaswerken organisation with results of the research, software and source codes.

The second type of interview was conducted through a series of formal talks between ICIS researchers and the following stakeholders: Province of Limburg (policy maker), LLTB (farmer association), Staatsbosbeheer regio Limburg (nature organisation), Gemeente Roermond (municipality), Bewoners Abdis Ademastraat Hammerveld-west (citizen group), and Gemeente Maastricht (municipality). The Panheelgroep (gravel extractors) refused any form of collaboration with us because they supposed our questionnaire might reveal delicate information about their operation. The representative of the nature organisation, 'Natuurmonumenten', was not able to commit to any of the proposed appointments.

The interviews were structured according to the cognitive agent architecture described by Conte & Castelfranchi (1995). In other words, we asked for goals, preferences and beliefs. In all of the interviews, the goals of safety, costs, hindrance and nature development were the most relevant issues indicated by the stakeholders. It was straight-forward to identify these issues. However, it was impossible to quantify them at this stage of the investigation. The only goal with a value was flood probability (the probability of an inundation that causes economic damage on public and private property) with a level of 1:250. This value was determined by Rijkswaterstaat and the Maaswerken organisation, and can be seen as a standard. It is remarkable that this value was acknowledged almost without any criticism. This fact suggests that the public has a high degree of trust in the water management authorities as experts. However, many non-experts have difficulty to coping with abstract notions such as flood probability. In addition, most stakeholders added specific requirements atop of the main goals. Some examples follow:

- The farmers association requires a special safety programme for farmers on properties between river and dikes.
- The municipalities want to couple nature development with recreation, which is at some points contrary to the notion of nature development held by nature organisations.

- Citizen organisations want to have mobile dikes installed, since the view from houses on the river will be disturbed by permanent dikes. This option ,however, is very expensive.
- The interviews also reveal the fact that it is almost impossible to devote land to sustainable flood protection programmes such as “Ruimte voor Water” (VROM/V&W, 1997) (space for water), because of expected land prices for housing or commercial development.

The interviews revealed another methodological problem: it is not merely the Maaswerken project itself is difficult to understand for most of the stakeholders. It appeared to be problematic to convey the FIRMA methodological approach to the stakeholders. For this reason, an easy-to-understand description of our models and the participatory process was written and sent to the stakeholders in preparation of the next step in the participatory process.

6.3.2 Model validation with stakeholders

Model validation with stakeholders is still in preparation and will be conducted in April 2003. The aim of this group process is to gain quantitative values in that match the perspectives of the stakeholders. The interviews enabled us to assign qualitative goals and beliefs to stakeholders who will later be represented in a model as agents. Quantitative values are necessary within a programmed environment. A detailed description of the model is in the WP3 documentation.

A way to retrieve values that may be related to the goals and beliefs is an interactive interface that enables stakeholders to test values with a physical model. The interface is a HTML site with embedded interactive Java applets. The stakeholder can sequentially enter values for:

1. measures on river bed geometry, nature area, dike building and clay storage,
2. cost parameters and hydraulic parameters,
3. the satisfaction levels associated with flood recurrence, costs, nature area, hindrance and extracted gravel according to their own beliefs.

The model of the environment is a simplified version of the Maas river basin, and can rapidly calculate results of parameter changes. The interface is designed in such a way that stakeholders are guided through the procedure of entering data. Additionally, an explanatory text with instructions accompanies the interactive text box. The

stakeholder is requested to focus on the implementation of data, and not to deal with procedural problems of data implementation. At the end of a data implementation session, a stakeholder may let the physical model calculate the results, and may choose between applying the results or recalculating with different belief/goal values. This way each stakeholder can experiment with his own parameters, and see the impact on a simplified environment immediately. This is performed in two steps:

1. The stakeholder may experiment with his own goal/belief values, and see the impacts of these values on the environment. The aim is to specify a realistic range of each of the values. This refers to the satisfaction level curves as described in WP3.
2. The stakeholders see the results of any other stakeholder, and can in this way see the impacts of his own actions on the others (table 6.1). This comparison gives a good overview of the reactions of every stakeholder and can serve as basis for discussion that may lead to changes in the strategy, the beliefs or even the goals of the stakeholders.

	Preferred alternative				Green for Gravel		
Stakeholder	**pm:**	**no:**	**ge:**		**pm:**	**no:**	**ge:**
Future state:							
Flood recurrence (years)	**823**	**174**	**1012**		**953**	**206**	**1345**
Water level decrease (meters)	*0,37*	*0,24*	*0,42*		*0,4*	*0,28*	*0,46*
Critical discharge (m3/s)	*3694*	*3471*	*3779*		*0,4*	*0,28*	*0,46*
Nature area (ha)	**75**	**75**	**75**		**100**	**100**	**100**
EOW index	**86**	**67**	**86**		**56**	**50**	**56**
Implementation costs and benefits:							
Extracted gravel (mln tons)	**6,6**	**6,6**	**6,2**		**7,9**	**7,9**	**7,5**
Costs (mln EURO)	*44*	*44*	*51*		*56*	*56*	*64*
Benefits (mln EURO)	*55*	*55*	*48*		*67*	*67*	*58*
Net Costs (mln EURO)	**-10**	**-10**	**3**		**-11**	**-11**	**6**
Hindrance (1000 person*days)	**31**	**31**	**31**		**40**	**40**	**40**

Table 6.1: Comparison of results based upon stakeholder parameters

Table 6.1 displays results of the interaction of three stakeholders, policy maker (pm), nature organisation (no), and gravel extractor (ge), with the model interface based upon two planning strategies 'Preferred alternative' (Maaswerken, 1998) and 'Green for Gravel' (Stroming, 1991). Nature and economic features are represented by some significant parameters (first column).

Each of the strategies contains the same set of measures. However, the table displays a variety of results, which can be derived from the fact that stakeholders may employ their own 'belief values'. The grey fields display values that are beyond the acceptable range or satisfaction level of the related stakeholder. The nature organisations want more nature area, the gravel extractors want less costs, etc. The fact that every stakeholder may include his own beliefs in the calculation entails the incorporation of more uncertainty. However, the origin of uncertainty is clear, and moreover, a discussion about eventual new strategies can focus on the intrinsic issues of this complex problem.

6.4 Conclusion

The Maaswerken project is a complex planning procedure, and appears to be a challenge for all involved persons and organisations. Decision makers as well as experts are therefore in a dilemma between the integration of many issues, perspectives and methods, and a reasonable level of simplification. The project always utilised a top-down approach and cannot be transformed into a bottom-up

approach, although a large number of stakeholders and stakeholder groups are involved. The complexity of the problem demands a well-organised team of experts as well as an acknowledged mediator with high communication skills. All of this has been attempted by the Maaswerken organisation with some success. Some might say that the specific character of the Dutch society as a consensus society suggests a high level of democracy including the possibility to express individual views publicly than in many other European countries. However, this can lead to a long and cumbersome decision making process.

Additionally, in a top-down approach the number of strategic alternatives is limited by some political, or administrative constraints. Alternatives beyond these political constraints are often not possible. Geldof (2001) describes these situations as political lock-ins.

Yet, the FIRMA team studying this particular case study has the opportunity to at least take alternative strategies into account. This approach has a lot more freedom in the choice of methodology than the Maaswerken organisation itself, and testing these alternatives is a central task of the Maastricht team. The combination of modelling techniques and stakeholder participation suggests a way to deal with complex problems in a planning procedure, and can even incorporate more uncertainty and perspectives of stakeholders in an early planning stage. The weakness of the Maaswerken approach is the long decision making process. The FIRMA team is able to focus on sensitive points within a negotiation process. Table 6.1 shows in a simplified way of indicating problems, and display whose opinion lies beyond the range of consensus. A shift in beliefs and even goals indicates processes of social learning. Similar values indicate co-operation or at least possible co-operation among partners in a negotiation process.

In this case study, the FIRMA team had to rely on a predetermined stakeholder platform. Results of the process can thus only be seen as ideas and suggestions for future projects such as IVM (Integral investigation of the Maas) (RIZA, 2001), where the impact of climate change on the Maas river basin is included in the investigation. Participatory methods conducted by the FIRMA team have always an experimental character, but can never influence the course of the Maaswerken project.

The combination of ABM and IA methods is, however, not always easy to understand for many stakeholders. Therefore, a good information campaign was necessary.

The FIRMA approach to the Maaswerken project cannot deliver new results nor can it have any impact to the project. However, the analysis of the project and the application of new methods give way for the development of new decision support tools where the social aspect of such a project is incorporated in an early phase, and the problem of uncertainties is indicated.

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7. PARTICIPATORY PROCESS IN ORB VALLEY CASE STUDY

O. Barreteau, F. Cernesson, P. Garin, L. Rousseau, A. Boutet, S. Bernard, A. Richard, G. Deffuant, Cemagref

7.1 Introduction

The Orb valley case study is dedicated to the support of a river institution "Syndicat Mixte de la Vallée de l'Orb" in its job of concerted water management at a river basin scale. The purpose of this support is to provide them with tools and methods to have on one hand a mirror of their action and on the other hand a mean to facilitate dialogue among actors on specific issues in the basin. It takes place in the context of tools development to enforce the French 1992 water law and the new European WFD, more specifically at the level of the frame of collective action. Our global assumption is that models and computer tools can be studied as mediating objects in the negotiation / discussion process. We follow two directions testing this assumption on these two kinds of objects.

- First, we test in which extent an agent based model might be used this way (Rouchier et al., 1998). We focus here on participatory modelling.
- The second object we test is a tool building a set of representations of viewpoints and their comparison, on several territory planning scenarios. These viewpoints are simple evaluations done by the actors on the results of a model. We focus here on a decision making view of a participatory process.

Our two directions fit in well with the on-going collaborative water management process within the Orb basin. Herault department and district councils are organising a participatory process for this collaborative integrated management, instituted in a "Contrat de Rivière" ("River Contract" whose frame is slightly predefined in the law). This local participatory process takes place within a "Syndicat Mixte de la Vallée de l'Orb (SMVO)", whose members are each village's district councils and the department assembly ("Conseil Général"). It involves also a specific institution, the "Conseil consultatif" (advice council), which is made of NGOs related to water affairs (ecologists, fishermen, riverside land owners…), professional representatives (tourism, agricultural or industrial corporations…), private companies and other

public bodies involved with water management in this basin. We benefit also a lot from the strong and positive support of Laurent Rippert, an engineer employed by the SMVO, “animator” of the basin and lead organiser of the process, whose knowledge of the people as well as of the hydrological processes is a key factor to make the process run. The issues dealt with by the SMVO are according to a decreasing importance: floods, water quality and treatment in rural areas, river banks upkeep, water scarcity in summer time.

The process has been beginning progressively some ten years ago but knew an official start with the creation of the SMVO and the signature of the contract in 1996. At this moment SMVO took up the carrying of the project taking over from the department assembly and the agricultural representatives. By the time being, studies have been realised, the only works already done are small according to their costs: river banks cleaning. One of the current issue is now how to transform in hard works these studies. All the process takes place in a rather feudal society, with local “lords” (mayors, “super mayors”…) who are obliged crossing points to be in touch with actors depending on them. Even if this description may appear like a caricature, it is still a reality to some extent, at least in rural areas. Even for the relation with the newly born institution SMVO, this mode of interaction within the area is still alive. Our relation with the process is mediated by the SMVO president, or his representative, Laurent Rippert. Our relation with the process is thus loosely mediated through Laurent Rippert so that our tools and methods could be involved (and tested) in the process. This mediation is “loose” and even more and more loose as the knowledge and the confidence between SMVO and Cemagref is greater. After a first stage of “control” and systematic mediation, it is now rather a help to find the relevant stakeholders and actors to learn about the system.

7.2 Objectives of the participatory processes

We now describe the main objectives of our contribution in the participatory processes, following our two directions.

7.2.1 Objectives of the participatory modelling process

In the first direction, it is necessary to make people agree on the suitability of the model to be used as such a basis to support dialogue and simulate scenarios. This implies to open the black box (Barreteau et al., 2001). Therefore we use participatory methods as soon as the modelling process making people participating in the building of the model and thus have a better knowledge of its content. We also use participatory methods to assess the relevance of the tool to represent their system and to be the basis of discussions about the system. The focus is here on the legitimacy of the tool and on a larger scope of the methodology that is used in order to raise the probability of success.

Another indirect purpose is to enhance the collaboration and collective work among stakeholders through a better knowledge of one another. Modelling constitutes in this case a way to make people discuss about their real system through a discussion about the model. The final existence of the model nor its use is important or useful for this purpose. Our objectives in using PM in our area are thus three:

- enhancing the legitimacy of the tool
- learning about the field and validating the acquired knowledge
- sharing representations

7.2.2 Objectives of the participatory decision process support approach

In our second direction, we follow a decision making approach of participatory process. Concrete participation of a large number of stakeholder poses some difficult problems. The most difficult one is to be able to formulate a main decision problem to deal with. This problem must be understood and accepted by all the stakeholders. Moreover, it has to represent the main stakes. Then, a problem is a “common” description of the territory that supports the expression of several evaluations, representing the expression of the stakes in a given scenario. Completing our first direction, we work on the representation of the evaluations of the group. These representations are built on the comparison of these evaluations to highlight agreements and disagreements. Our main assumption is that these comparisons induce integrated discussion and then integrated decision making. We have build a tool to

support the expression and the comparison of these viewpoints about the results of a model on a set of scenarios. The representation of actor's viewpoints is a help in case of complex systems and the comparisons are intended to make clear the possible sources of conflicts and possibilities of agreement whenever these viewpoints are absolutely fixed. The expected result is a better cross comprehension that guides collective information search and group problem formulation. Notably, this collective information search allows the stakeholders to ask collective questions to the modelling team. Then, we complete here our first direction by explicitly linking stakes and models, in a participatory process. Our main objectives in this direction are to test:

- the kind of representations we use: are they clear and operational?
- the accuracy of the viewpoint comparison to link individual and collective levels
- the use of such a tool in realistic situations

7.3 Involved Actors

Our two directions are tested in separate case studies. They take place within a pre-existing participatory process of water basin management under co-ordination and supervision of Water Basin institution (SMVO), as detailed in participatory chapter.

In our first direction we have planned and are currently undertaking a two scales interactive modelling process with local stakeholders. The assumption is first that such a process should enhance the effective use of tools which it might lead to, second that such tool has a stronger legitimacy from the viewpoint of the concerned stakeholders. We first describe the three kinds of groups involved, their stakes (or presumed stakes) and their actual involvement:

- researchers,
- basin managers (or field experts),
- local users.

Researchers team is gathering computer scientists, water scientist and geographers with a strong interest in modelling issues and especially agent based and desegregating modelling. This modelling is to be integrative (at least disciplinary but

also spatially) and aiming at supporting or facilitating participatory assessment of the overall water basin management process. Even if the purpose of the research team to produce any tool which would be used in the actual process, it is meant that the produced tool would be a prototype of a tool which could be used in a water basin participatory management process. The involvement of these researchers is multiple levels:

- designing and producing models,
- getting data from the field,
- getting feed backs on the tools produced, their quality and their potential use,
- presenting the progress of the whole research project to interested stakeholders,
- simulating the use of such tools in specific session with a chosen sample of stakeholders.

The initial assumption of this team is to base their interaction process with local stakeholders on a privileged relation with the Orb Valley institution. Several reasons lay behind this strong and a priori biasing assumption:

- SMVO is the institution leading the actual water management process and gives the initial allowance to work on this field (although no specific request nor constraint of that kind was asked for by this institution at any time of the research process). Some kind of moral engagement towards this institution is thus endorsed by researchers;
- SMVO is actually facilitating the all research process, notably through providing data and “opening doors” (although no specific attempt has been made to get in touch with stakeholders without the intermediary of SMVO;
- Water Basin institutions should be the potential users of such tools in their facilitation role of participatory process. Therefore they should be more closely involved in the design process.

Second kind of stakeholders is managers, whose prototype is SMVO. This category gathers also all levels and sectors of administrative services provided their territorial basis is larger than the basin, so that they can't be considered a priori entitled in the defence of any geographically based particular interest versus the whole basin

interest. In this case study, administrations of the following entities are concerned: nation, region, county. In this category are stakeholders who claim to have some legitimacy regarding water management in Orb basin.

For the sake of model design and tool use simulation, this category is extended to stakeholders with same profile in other but neighbouring basin: stakeholders with the same role as SMVO in their own basin. The purpose in including them is twice:

- enlarging the sample of basin institutions which has a major place in the researchers' assumptions and would otherwise be reduced to only one by construction, in order to enrich the discussions and the diversity of points of view;
- improving the potential applicability of any results of the research process.

It lead to the actual constitution of a four and then five stakeholders group constituted of:

- SMVO,
- SIVU Ganges-Le Vigan (same kind of institution as SMVO in a neighbouring basin),
- DIREN,
- Agence de l'eau RMC,
- DDE (local representation of civil works department in charge of flood protection issues) has joined this group in 2002 for flood related issues only.

Other stakeholders have been invited to take part but could not manage to be as fully involved despite their interest. This group is involved in the design of the models through specific meetings. In 2001, two meetings have taken place:

- presentation of agent based modelling, two examples already existing dealing with water management but in other places and with other issues,
- presentation of a first model at the basin scale with a population dynamics focus (Edwards et al., 2002) which lead to large discussion on assumptions of the model and scenarios to be tested.

Although this first model was discussed and was rather calling for more understanding and improvement of interface, the process has then been interrupted the model being not satisfying from a modelling point of view. Stakeholders of this category, with a larger sample than this specific group, are also involved in a more classical way as information providers, as they have knowledge on what is going on in the basin and as their own behavioural patterns is to be included in the system dynamics.

Third category is the most diverse. It gathers elected people, associations (citizen concerned by floods, environmentalists…), socio-professionals (agriculture and tourism sectors mainly…), electricity national company… Even if the issue of representativeness has not been taken up precisely, it is considered that these stakeholders who are in a representing position are really representing people they are supposed to. This means notably that few individual citizens have been met directly. Their behavioural patterns and viewpoints have been grasped from interviews of their representatives (elected in local councils or associations). Also only their representatives are invited to and involved in each collective feed back progress meetings. Only some people with a specific professional activity, such as farmers, have been interviewed individually and invited to some collective feed backs meetings. This choice, and the game associations and lobbies play more specifically, is currently under study. It has been done in a first raw since representatives, even with a poor basis, have a broader knowledge on behavioural patterns than their own individual behaviour. It lead to some more or less controlled bias such as:

- hijacking of some collective progress meetings for the sake of competition between two citizen associations,
- neither direct access to individual information nor direct participation of individuals (understood as citizens) in the progress of work,
- possible uncontrolled and not understood manipulation of interaction with researchers of some stakeholders, even and often due to a misrepresentation of these stakeholders about researchers. Support and close relation from SMVO helped to tackle this bias.

Stakeholders in this category have been involved through two classical ways: individual interviews and collective feed backs.
Four batches of interviews have been undertaken:

- points of view on relevant spatial entities to describe water management dynamics at the basin scale (Brunet, 2000),
- analysis of four micro-conflicts,
- evolution of behavioural patterns (Maton, 2001),
- points of view on vineyard protection practices (Borderelle, 2002).

All interviews have been conducted either as half-structured or open. Some life narratives have been collected as well. Collective feed backs progress meetings have taken place either on an event or a calendar basis:

- after each batch of individual interviews, collective feed backs sessions were organised with all interviewed people,
- at the end of each year of work, broader feed back has taken place with all interested stakeholders. These sessions were however not as open as it might appear due to diffusion of information on the meeting itself. SMVO made invitations choosing addressees, according to either any involvement in the process during past of the research project or attitude towards actual basin management participatory process at the time of the meeting. These meetings have first been organised on a whole basin geographical basis for years 1 and 2. However hijacking of the meeting by a few citizen association is leading us to a more thorough analysis of their involvement and on the design of a specific plan of feed back in separate meetings at a more local scale, at which we expect less political behaviours to be activated.

In our second direction, we propose a prototype computer tool called SICOPTER. As a prototype, we do not use it in real decision process. We use the interviews to design role playing scenarios[1], and a group of actors played the roles for the test. The players are involved in the analysis of the results of the tests.

[1] See the document “Orb Case Study. Use of scenario” in WP5 report.

7.4 Participatory process

This first stage has actually consisted in the identification of the context and mutual learning of each other with various categories of stakeholders and ourselves. This mutual learning is very important since it is the condition for good and trustful work. After that initial stage, participatory process within Orb case study has mainly dealt with tools designed and/or refined through dialogue between the two first categories of stakeholders on one hand and analysis of viewpoints and the participatory context in which these tools would be used. Overall participatory methods which have mainly be used apart from open interviews for indigenous knowledge elicitation is participatory modelling and kind of focus group with the first two categories, institutional actors group extended to a few other representatives of agriculture or civil works department. Objective of this kind of focus group was to work on the tools with the issue of feasibility of using them with "3rd category" stakeholders in mind.

Interaction has mainly occurred between the two first categories: researchers and institutional stakeholders group, which constituted a regular working group. Six meetings have taken place with the two following activities:

- in our first direction co-building of an Agent Based Model of pollutants transfer in a sub basin, PHYLOU, in relation with a co-occurring mediation process on the same topic lead by a consultancy group on behalf of SMVO;
- in our second direction test and refining of SICOPTER, a computer tool design to support viewpoint comparison and integration. The objectives of the test is to design a computer assisted interactive methodology of use of negotiation support tools, in interaction with the actors. We use a virtual case study on an issue of flood management. This issue is really at stake in the basin but real actors of the issue are not supposed to be involved in the simulation because of the sensitivity of the issue. A role playing game with stakeholders of the management level group putting on roles of some local users active on this issue, members of the research team endorsing role of management institution acting as facilitators take over a real negotiation.

Initial plan of work was to enforce a close cooperation with institutional stakeholders working group for the “design work” of Phylou as well as for the computer assisted interactive methodology of use of negotiation support tools. Both of our two directions were to be discussed and tested through meetings planned in 2002 and 2003 with this working group, extended to local representatives of agriculture and civil works departments, because of the topics dealt with. We began with a classical work based on half-structured or open interviews. First, it allow us to study of the place of local NGOs in the participatory process. A complete survey of viewpoints of NGO leaders was conducted and showed that their wishes of involvement is varying a lot from one NGO to another one: from NGOs wishing to take part in the decision process in some kind of co-decision process to wards NGOs wishing to keep a critical posture without any responsibility in the decisions taken (Richard, 2002). Apart from variations according to part of the basin in which those NGOs are interested by, a second source of variation is thus dealing with the place wished by the NGOs in the decision process. The setting of use of tools co-designed with institutional stakeholders within this context of presence of various actors is thus still on-going in order to adapt to this diversity. Second, it allow us to better grasp the context of participatory management taking place in the Orb valley. Interviews confirmed for example that the slope is a relevant scale for farmers while whole sub-basin is not. Third, it allows us to elicit indigenous knowledge in order to feed the initial design process of Phylou and SICOPTER prototypes. These prototypes initiate our action in our two research directions.

Six meetings had been planned and scheduled:

- Prototype presentation and discussion and presentation of the computer based interactive decision support system;
- First test on SICOPTER on the accuracy of the representations used and on the system himself ;
- Presentation and discussion of a second step model;
- Second test of SICOPTER on the accuracy of the computer tool for the discussions on the stakes.
- Presentation and discussion of a third step model. If accepted, planning of demos of this model with local users.
- Third test of SICOPTER on the use of the tool in the animation process.

Among these six meetings which have been done, three of them have been specifically meant for Phylou co-design, each of them corresponding to a specific stage in the modelling process as shown by the figure below (from WP3 report). Only one was initially reserved to the test of SICOPTER. However, it appeared that the test of the interactive methodology of use of negotiation support tool interested the actors, but needed more than one meeting to reach our initial goals. We then added two other tests to improve the tool and refine our methodology.

A global first meeting was used to present the overall action in the project and to introduce the two directions of work on Phylou and SICOPTER.

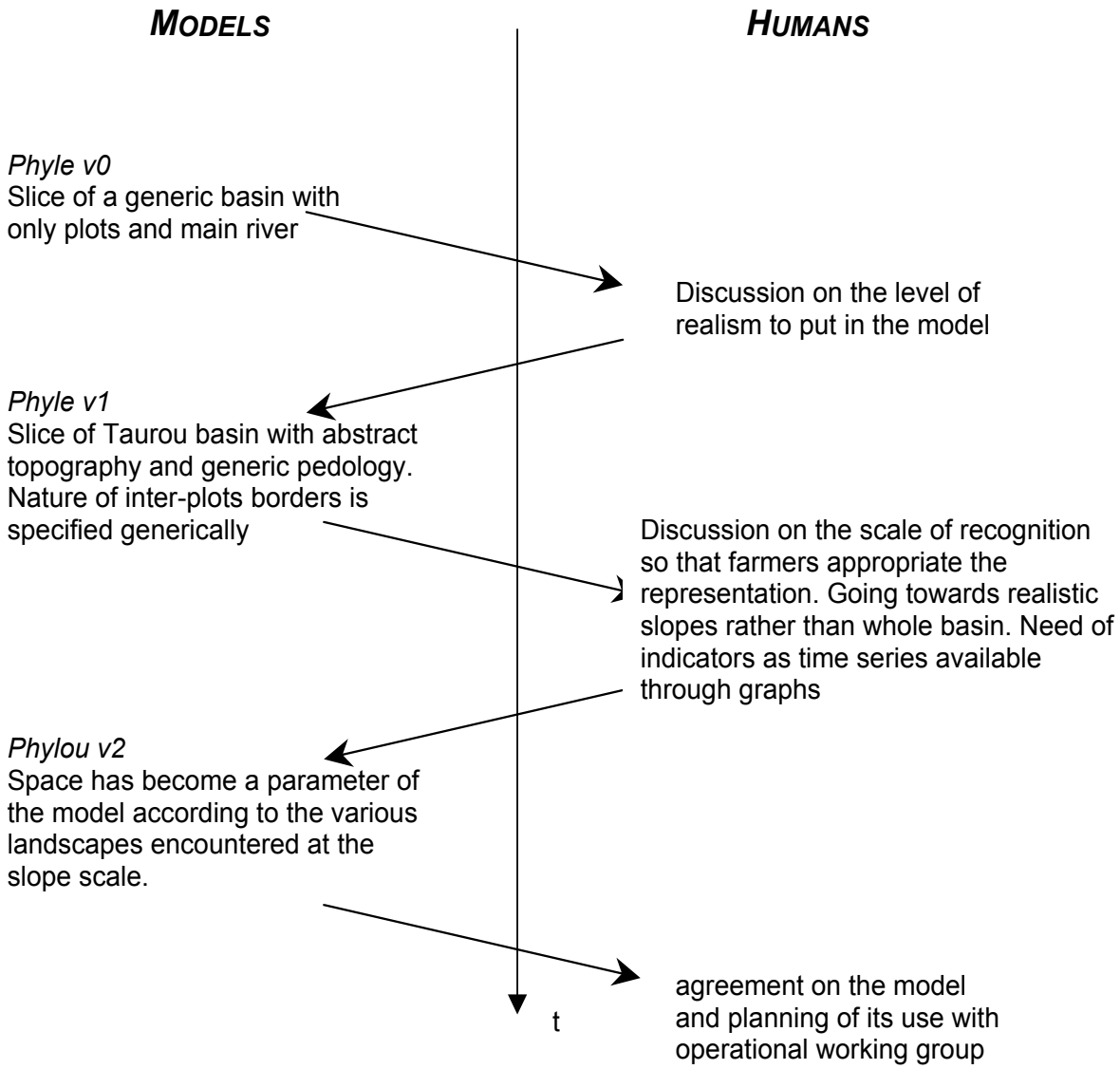

Figure 7.1: Interactions among models and humans in the Phyle / Phylou process

7.5 Enforcing participation with the Phylou model

We now describe the three meetings dedicated to our first direction. The first meeting was based on a very rough model, a square slice of a basin with a drain in the middle. It lead the discussion towards the necessity and the level required of realism. No real consensus has been reached within the discussion among participants, but the idea was mainly to set up items allowing actors of the basin to recognize the whole basin without recognizing his own plot, so that it might be used to foster discussion on collective rules rather than individual interests. Most institutional stakeholders are

expecting rather a training tool to communicate results to other actors rather than any decision support tool.

Second meeting aimed at Phylou co-design was based on a slice of Taurou basin with topography and soil use characteristics calibrated from real data and field survey. It lead the discussion on the suitable scale of model for actors to recognise their own basin: stakeholders proposed the slope (i.e. what can be seen by a farmer) rather than the whole basin, because it is through this scale that they experiment the basin in their daily life. As for the interface, institutional stakeholders were rather expecting graphs of evolution of specific indicators, such as the level of pollutants at the output of the basin, than the dynamic representation of pollutants being transferred in the simulated basin.

Third meeting aimed at Phylou co-design was based on a model consisting mainly on processes of use of pollutants and dynamics of transfer of these. Landscape, with all the issues of scale and recognition tackled before, had been dealt as a parameter of the model, with the typical scale of a few tens of hectares. Possible landscapes are depending first on its family (two different families in the sub-basin) and on the assumptions of structural management of these landscapes (for example the ratio of dikes or grass bands among borders between plots) (Borderelle, 2002). For institutional stakeholders, it had been assessed that it might be used with basin actors as a training tool provided that we organise its use with specific events, such as consequences of rain. In a first time it generated our participation to a meeting of the operational working group lead by the consultancy group on the issue of pollutants in water in the same sub-basin as the one which served as a basis for our work.

7.6 Supporting the participatory process with SICOPTER

We now describe the three meetings dedicated to testing and improving SICOPTER. They all were organised as role playing games, in which institutional stakeholders and some of researchers, put on roles of real actors of the basin, well known to be active in this issue of flood management in downstream part of the Orb valley. At the end of each test, a specific discussion with the players helped us to define the next test.

The first meeting allowed players to handle the tool and propose some modifications regarding the interface and some requirements of new specific indicators. This test showed us that the tool helps the players to quickly understand the results of the model and the evaluations[2] of others.

The second meeting allowed to test the whole protocol of use of the tool itself. It did not appear to support the whole integration, but it facilitated the expression of evaluations clearly linked to the result of the model. The way to use the tool in the whole process of the dialogue facilitator, appears to be very important and to need some clarifications and refinements. However, the test of this tool led us already to learn on the way the facilitator uses it, since he had to uncover it in order to explain why he was not totally at ease with the introduction of the tool in the process. We then pointed out the importance of an animation scenario that define the way to use such a tool. It has to be seen as a part of the role playing scenario in the test[3].

The aim of the third meeting was to test a specific animation scenario. We alternated two kinds of phases. First a scenario was evaluated with the tool and second the facilitator used the viewpoints' visualisation to present a synthesis and opening further discussion on new scenarios to be tested. The results showed that the process works well and that the presentation of the viewpoints comparisons induces the actors to develop their evaluation in term of stakes. Then, with a limited set of tests, we showed that such a tool can be used both to progress in the choice of a globally preferred scenario and to induce a better mutual comprehension.

The two main results of these tests are :

- such a tool helps the players to understand the scenarios and each other's evaluation,
- the outputs are useful for the animation of the discussion.

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[2] Evaluations themselves not the stakes they represent.
[3] For an extensive presentation of this question, see the document "Orb Case Study. Use of scenario" in WP5 report.

Moreover, using these tool and methodology improves the participation of the actors in the definition of a common problem.

7.7 Conclusion

Our two directions provide good examples of the use of models and computer tools to support participatory processes that lead to build shared representations of the territory and of the actors' stakes. We demonstrated that it is possible to propose specific tools and methodologies that facilitate knowledge integration and collective problem formulation. Participation can then be improved in two directions: first, participation in the design of the model that improve legitimacy and confidence in the common information and second, participation in a decision making sense that improve mutual comprehension and group information search. Such improvements ensure a more collective decision process but are not intended to systematically resolve conflicts between actors. On the contrary, we claim that building common representations of the territory and eliciting conflicting stakes is a crucial step to formulate an integrated problem in a territory management process. Then, our tools and methodologies have to be used to induce a learning process, not to prematurely propose a definitive solution.

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8. STAKEHOLDERS AND PARTICIPATORY METHODS IN THE THAMES CASE STUDY

Cindy Warwick, Environmental Change Institute, University of Oxford
Tom Downing, Stockholm Environment Institute, Oxford Office

8.1 Introduction

The Thames case study has investigated two different aspects of the integrated water system in the Thames region – domestic water demand and drought management. These two examinations have required different problem specifications and agent descriptions.

This paper will briefly introduce the two different issues and then detail how the how this impacted participation approaches. For each issue the purpose of participation, the main types of participation, the stakeholder platform and results and future work will be discussed. Finally, key differences and their impact will be summarised in the conclusions at the end of the paper.

8.2 Overview

The current population of the Thames region is 23% of the population of England and Wales (on less than 9% of the area). Government household projections, developed for the period 1991-2016 predicted that there would be 1,425,000 new dwellings in the South East up to 2016 although it could be as much as 1,638,000. This potential for increased population combined with per capita increases in water consumption has put pressure on water supply systems. At present, Thames Water Utility Ltd (a privatised water company operating in the Thames region) estimate that there is little or no headroom (difference between forecast water availability and demand)—total, unrestricted demand across the region is greater than available supply. An increase in supply and further demand management is projected, to allow a headroom of some 120 Ml/d, about 5% of the distribution input in 1997/97 of 2670 Ml/d.

The last drought experienced in the UK was experienced between 1995 and 1997 (Brown 1992, IOH 1995). In South East England this was experienced as the most severe groundwater drought since records began. This drought prompted a government call for better drought planning on the part of the privatised water service companies (DETR & Welsh Office 1999). The Water Companies then developed Drought Contingency Plans that set out the way that each company would monitor and respond to drought events. As part of this process, the Environment Agency (the environmental regulator for water resources abstraction) developed national guidelines for drought contingency planning by the water companies (Environment Agency 1999a) and a drought management manual to develop drought management plans for each of the eight Environment Agency Regions across England and Wales.

In general the drought management and drought contingency plans produced under the new drought-planning regime include: information on roles and responsibilities within Drought Management Teams; environmental monitoring (of drought triggers and drought impacts); options, actions and mitigation; reporting arrangements; and reference materials (see as an example Thames Regional Drought Plan (Environment Agency 2001)). What is not described in the drought planning documents are many of the behaviours associated with implementing the plans. Though options for managing supply and demand are listed, there is little-information concerning why any particular option would be selected for implementation in any particular circumstance. There is also no description of what negotiations occur, and how they occur, when the different parties involved in drought management do not agree on the management strategy. The plans are not generally shared with the public and no testing of the plans has occurred, especially between stakeholder organisations with different management priorities.

One of the potential options in drought management is to ask for voluntary reductions in water use. A more severe option is the banning of particular water uses (such as a hosepipe ban for household consumers). The effectiveness of these options in supply-demand planning depend upon assumptions that the water companies and EA make regarding the implementation of these bans by individual households and how these assumptions are, or are not, matched through changes in consumption.

Responsibilities related to water management in the Thames region are divided between many public and private organisations. The water industry in England and Wales was privatised in 1998. Privatisation led to the creation of private water companies and a regulatory framework for their operation. The Environment Agency (environmental regulator of the water industry) is responsible for water quality and water resources. This remit covers resource planning and the licensing and regulation of water abstractions, including abstractions by water companies. It is also responsible, in whole or part, for pollution control, fisheries, navigation and flood defence. The Office of Water Services (Ofwat) is the economic regulator of the water industry. Ofwat is charged with the duty to ensure that the appointed companies are able to properly finance the carrying out of their functions, Ofwat sets the 'price-cap' limit on increases in the consumer tariff basket every five years (Helm and Yarrow 1988, Littlechild 1988, Armstrong et al. 1994). Facilitating competition, promoting efficiency on the part of the water utilities, and protecting the interests of consumers are secondary duties (OXERA 1994). Policy making on resource management in the UK is undertaken by central government through the Department of Environment, Food and Rural Affairs (DERFA).

This project aims to bring together many of the stakeholders in the South East England water polity to explore issues related to water management using agent-based modelling approaches. In line with the issues described above, the project aims to explore behavioural aspects of household water consumption to understand problems with traditional forecasting and assumptions surrounding household demand scenarios. It also aims to understand drought management behaviours; how management plans will be implemented and the eventual outcomes. Ultimately, these two portions of the project will link together in the examination of household behavioural responses to policy messages aimed at changing consumption behaviour in times of drought.

For a detailed explanation of the issues being addressed and stakeholders being engaged, please see the South East England case study submission for WP2. Full details of the Thames household model are given in WP3.

The following section describes the participation programme undertaken to pursue these project aims. As the household demand and drought management portions of the project were conducted separately, the next section on participation has been divided into two subsections, one for each topic.

8.3 Participation

8.3.1 Participation in domestic demand modelling

8.3.1.1 The purpose of participation

The purpose of the investigation into domestic water demand in the FIRMA project is to improve demand planning and management by using agent-based modelling to explore behavioural factors and dynamics possibly at play in domestic water consumption. The modelling and participation were conducted along side a project where demand was being discussed in the context of possible socio-economic scenarios. The agent-based modelling exercise was used to learn about factors (not described in the socio-economic scenarios) that could impact on demand. The stakeholder forum was used to: solicit information regarding plausible relationships for model development; request available data on household demand; validate model operation and outputs against expert opinion; and to put the assumptions made under the scenario programme into perspective for project participants. In other words, the participation programme was a way to discuss with water management stakeholders the possible impact of behavioural factors in consumption, propose plausible relationships and validate modelling assumptions and outputs.

The participation programme was primarily top-down in nature. The agent-based model was developed by the project team with input, comments and supporting data from stakeholders. Stakeholders did not play a major role in defining the model or the scope of their participation. Also, the stakeholders involved were not (for the most part) describing their own behaviour but the behaviour of household agents and how they influence them, again in a top-down fashion. Therefore the process was top-down both in the relationship between the project team and the participants and the participants and the agents.

This top-down approach was considered to be an appropriate in two ways. First, the relationship between the project team and the stakeholders was considered to be a first step in interesting stakeholders in agent-based modelling and participative approaches so that stakeholders would be interested in greater degrees of participation in future projects (for example the drought management half of this project (discussed in the next section)). Second, the water management stakeholders consulted possess data sets and personal knowledge regarding large-scale water consumption behaviour that was required to assess the appropriateness of the model. Finally, the water managers were actively looking at the issue of household water demand and could use the model to asking more interesting questions about future demand potential – the stakeholders had capacity to act on anything they learned from the model. Therefore, this group was appropriate for discussing household agent behaviours as they had data and expert experience about aggregate agent behaviour, they had questions regarding that behaviour and they had capacity to act in response to project developments.

Ideally in this case, the participation process would also have involved householders for a more bottom-up approach to model building and application. For instance working with householders to identify and test other potential impacts on their consumption behaviours. Unfortunately, this could not be pursued within this project but proposals for further work are being developed.

As can be summarised from above, the participation methodology used was largely one of consultation with knowledgeable stakeholders and this was conducted to generate interest for more intensive participation, and to validate the model using collected data sets and expert opinion. This methodology does leave gaps between the participative process and the modelling but, in this case, the model is being used as an exploratory tool, not a tool for consensus building, and in this circumstance, the gaps do not interfere with the goals of the process.

8.3.1.2 The main type of participation undertaken

The main type of participation undertaken was data/knowledge elicitation and consultation for model validation. The model was discussed and demonstrated with

expert stakeholders to formulate approaches, consider the plausibility of assumptions and outputs and generally validate the model. There is no specific decision that stakeholders are required to make on this issue and no negotiation was required in the model or in the participatory process. However, water companies and regulators are constantly planning and operating based on assumptions regarding household consumption behaviour. Questioning of this behaviour, through the use of an agent-based model, could revise assumptions, forecasts and water efficiency strategies used by water companies and regulators.

8.3.1.3 The stakeholder platform/steering group

The stakeholder platform (project steering group) was brought together as part of a project on climate change impacts on the demand for water. The steering group consists of approximately 12 people representing 8 organisations, namely the Environment Agency, OfWat (Office of Water Services) and DEFRA (Department of the Environment, Food and Rural Affairs) and a number of water companies. The platform meets approximately 3 times per year. The progress and findings from the agent-based modelling programme is only 1 item on the agenda when the group meets and sometimes it is not discussed at all. Occasionally (maybe once per year) a larger stakeholder group is convened to share progress and ask for feedback beyond the smaller, stakeholder platform group. This larger group includes greater representation of the organisations on the steering group and additional groups form the quango and NGO communities. Though membership of the steering group is relatively fixed, the membership of this larger, stakeholder, group is more fluid.

The stakeholders engaged primarily operate at national or regional scales. They are generally decision-makers or people of influence in their respective organisations. For the most part, these stakeholders have extensive experience in water management but lack insight into household consumption behaviours that may be behind aggregate consumption patterns.

The role of the modelling in this participatory process was to demonstrate the potential for alternative explanations of patterns in aggregate demand. If these assumptions are seen to be reasonable and results achieved a degree of correlation

with observed patterns of water use then stakeholders can consider 1) how the understanding of behaviours described could help to improve demand management and water use forecasting and 2) the relative importance of other socio-economic or climate impacts on consumption behaviour.

What is missing from the participative programme is the household stakeholders or a representative of consumer interests and issues. Participation from this group would be useful and informative but this will need to be pursued through another project.

8.3.1.4 Results

No formal evaluation or review of the participatory programme was undertaken for this project. However, some general comments can be made regarding the qualitative results of the work. In general, the modelling and participatory processes have lead the stakeholders in the project steering group to question new factors related to household water consumption. This will not have a direct impact on decision-making and planning in the immediate future but it is an effective first step towards the consideration of human behaviour in analysing aggregate demand. An immediate impact could be the design and implementation of new data collection initiatives that would help with the further examination of these behavioural issues. The participatory programme showed that stakeholders were interested in the behaviours, the way they were being explored and the possible application of this information to demand planning. However, stakeholders did not see any immediate application of the modelling or the knowledge gained through the participatory programme in their regular operations.

As a final report, a description of the modelling undertaken and a summary of qualitative findings will be sent to the project steering group for review and then will be available to the larger stakeholder group and the wider public. The report will be published on the internet as part of the investigation into the impact of climate change on household demand.

8.3.1.5 Future Work

Further work on the motivations for consumptive behaviour in households and communication between households would be useful in improving the model and making it more useful to stakeholders. Increased data on consumption in individual households (as opposed to aggregate data for an area) and motivations behind them (to be gathered through interviews with householders) would be most useful as this was a definite gap in the available data. This work would involve a new stakeholder group (household water users) and possibly new types of participation.

Further development of the policy agent behaviour is discussed in the following section on drought management modelling.

8.3.2 Participation in drought management modelling

8.3.2.1 The purpose of participation

The main purpose of the investigation into drought management in the FIRMA project is to understand and improve drought management under the recently instituted drought planning regime in England and Wales. The investigation can be divided into 3 sections (only some of which will be completed during the FIRMA project):

- working with stakeholders to understand important factors in drought management - their procedures, decision-making criteria and viewpoints. This portion of the programme focuses on knowledge elicitation and data collection
- role playing with stakeholders to further understand drought management practices and observe negotiation behaviours and strategies. This portion of the project should also facilitate social learning within the stakeholder group
- using an agent-based model (developed from interview information and role play behaviour) to share viewpoints, test strategies and explore drought management options

This participation process is seen as being bottom-up in nature. Stakeholders describe their own behaviours and are helping to provide the structure and content for the agent-based modelling and application programme. This is considered to be an

appropriate approach because a significant amount of information is needed before a model can be developed and no one is better qualified to give that information than the stakeholders directly involved. The participatory methodology has been chosen to facilitate model building and application.

In summary, it is hoped that the participation programme will lead to the development of an agent-based model and that the participation programme, model building and model application will result in: a better understanding of drought management by the research team and the stakeholders involved; a testing of the current drought plans and their implementation; and better understanding of negotiation behaviours. At present, no substantial gaps between the participation methodology and the modelling are seen but these may emerge as the project progresses.

8.3.2.2 The main types of participation undertaken and expected

The main type of participation undertaken, to date, has been data collection/knowledge elicitation. However, this process was undertaken in quite a different manner to the data gathering and knowledge elicitation undertaken for household demand modelling. In this case, data is required in the first instance to design and build a new model as opposed to enrich and validate a built model. Due to the type and depth of data required, stakeholders were interviewed individually, or in small groups, in sessions strictly devoted to the drought management aspects of this project.

Participation in a role playing game is the next type of participation expected. Stakeholders will be asked to work through the management of a simulated drought exercise. The roles played by stakeholders, members of the project team and volunteers will develop as the game evolves.

The participation and modelling programme does not relate to a specific decision that needs to be made by the water companies or regulators. The programme looks at the hypothetical implementation of drought management plans under different climate scenarios. However, at some point in the future, there will be a drought and these decisions will need to be made ‘for real’. It is hoped that the social learning and new

perspectives on negotiation generated through this project will increase the effectiveness of management, when the time comes.

8.3.2.3 The stakeholder platform

At present, there is no fixed stakeholder platform for the drought management portion of the project. Instead, stakeholders (or organisations) are approached individually for specific contact. A more formal, mixed, stakeholder group will need to be formulated from these individual contacts when the role-play game becomes playable by multiple stakeholders.

Stakeholders engaged through this process generally have a high level of influence within their organisation and would be involved directly in drought management and management negotiations, should a drought occur.

8.3.2.4 Results and further work

The programme of work, as it is now formulated, is that through gaming we will be able to learn both about drought management and negotiation behaviour (in the context of drought management) before building a simulation model. This is as opposed to building a model based on external concepts or theories and then seeing if they fit the real situation. This is especially important (and necessary!) since no established model for negotiation in such a context has been developed. This was found to be a major problem when, at the beginning of the project, we were expecting to begin by developing at least a simple model to run and validate with stakeholders. The lack of behavioural data on negotiation and translation of that behaviour into agent-based code forced the participation-led approach now being undertaken.

Current results are an intermediate step to our final goals. Information on procedures, options and decision criteria for drought management is being gathered. The social learning expected in gaming and model application has not yet been generated.

8.4 Conclusion

The South East England case study has undertaken two participatory modelling exercises. The first used a relatively established programming framework and stakeholders were consulted on the validity of modelling assumptions and outcomes. The second, not yet complete, exercise is starting with stakeholders as active participants in model development and design. The difference between the two approaches centres around the fact that the household demand problem had a defined stakeholder platform with established questions and problems. The problem could also be explored using relatively conventional agent-based programming techniques. Conversely, the drought problem has stakeholders but not an identified stakeholder platform. Questions and problems related to the topic are not generally discussed between stakeholders, only within each stakeholder organisation. Because this problem involves a small number of complex stakeholders, programming approaches and techniques are also less established. In both agent-based approaches undertaken, the participation of stakeholders is key but the nature of that participation differed.

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9. PARTICIPATION IN THE ZÜRICH CASE STUDY

Matt Hare, EAWAG

9.1 Explanation of problem

The dominant infrastructure planning policy of the WVZ over the 20th century has been characterized as risk-averse "worst-case planning" (Tillman, 2001) in which past increasing demand patterns have been expected to continue and supply capacity has been built to meet a level of demand based on the "upper side" of that possibility. This policy worked well until the 1970s in that it met the legal requirement for water supply security and, while demand increased as expected, it also met the city norm for high water quality, and appeared to be financially secure and efficient (infrastructure costs seemed to be proportionate to the demand for water and the WVZ was financially supported by the city). However, problems began when there were two contradictory responses to a particularly dry summer in 1976 in which demand peaked close to the maximum level of supply capacity. The first response was that the water utility again increased supply capacity to avoid future problems. The second response was that demand fell in an unprecedented fashion due to increased water saving by the WVZ and the consumers, combined with a general decline in water-using industries, such as Beer manufacturers. The result was that pumping capacity has increased to the point that capacity is now approximately 2.5 times daily peak demand.

Such security-minded planning is also responsible for the WVZ's recent desire to build more, smaller distributed reservoirs; to try to balance the capacities of the three water works; to increase the use of river water, as well as groundwater, and to complete the *ringstollen*, a water distribution network that would allow any one of three water works to supply the entire city (WVZ, 1999).

As a result of these events, the Zürich Water Supply Utility (WVZ) maintains a water supply system that operates at a high level of security that would be the envy of the world. In summary, this security takes the form of

- a pumping capacity 150% higher than peak and average demand levels
- a high, distributed reservoir storage capacity
- water works exploiting three different sources of water

- a flexible water distribution network in the form of the *ringstollen* which currently links two out of the three water works
- a second emergency water distribution network

This level of security is very expensive to support financially due to the high level of fixed costs involved in developing and maintaining infrastructure. The nature of the costs, such as the need to service interest payments, means that the financial burden will endure for many years to come, even if the infrastructure were to be reduced. These costs will be expected to rise as the water utility aims in the next years to increase this level of security further by completing the *ringstollen* so that all three water works are linked.

Meanwhile, as mentioned above water saving among consumers and the WVZ, plus industrial decline has led to a fall in demand. In addition, the WVZ is now no longer funded by the city. It must cover its own costs. Despite the corresponding fall in income, in the last few years, the WVZ has managed to move the utility out of debt and into a financial surplus, but this has been largely due to a halving of net investment costs, reductions in interest payments and efficiency savings in manpower. Whether it can maintain its surplus budget in the event of future decreases in water demand is uncertain. Perhaps because of this uncertainty and certainly because of the cost of the current infrastructure, it has found that its attempts to get permission to spend money for the completion of the *ringstollen* have been voted down by the City Council.

What appears to be happening is that there is increasing conflict between three norms within the community :

- water security must be high - it is enshrined in law that water must be available in sufficient quality and quantity at all times (but this costs a lot of money to maintain and costs cannot be reduced in the short or medium term)
- water saving is a good (but this reduces the income of the water utility, thus threatening its ability to maintain the costs of high levels of water security, i.e. its financial security)
- the financial security and efficiency of the water utility should be high in terms of being able to support its activities without going into debt (completing the *ringstollen* was seen as an inefficient use of money, therefore water security is not able to be maximised)

The questions that need to be asked: is how can these three norms be balanced in future? Is the current level of security efficient? What level of security do the people and politicians of Zürich desire? How much are they willing to pay for it, and how can it be achieved by the WVZ for this cost?

Once the desired level of security is known, then one can look into the methods, costs and possibility of maintaining it given changes in future water demand in the city. Levels of demand will depend on the consumers' water saving behaviours, housing associations and manufacturers of water saving household and industrial appliances, and how much the city chooses to try to manage demand. The level of demand will also affect the ability of the WVZ to pay for the security required, since income is dependant on revenue from water charges.

Finding the answers to these questions involves seeking the support and opinion of many different stakeholders: consumers, politicians, water utilities, housing and consumer associations, professional associations of the water industry and manufacturers.

9.2 Stakeholders and the actors' platform

The role of the Swiss case study team was to bring together the city's water management stakeholders within a discussion group, referred to here as an *actors' platform*, as part of a long term participatory process lasting from Autumn 2000 through to Spring 2003.

Nine stakeholders in the actors' platform included city representatives of the water utility, the wastewater utility, a manufacturer of water using technologies, the architects' association (SIA), the plumbers' association (SSIV), the consumers association, the association for water and gas utilities (SVGW), and a local politician (see Table 1).

Table 10.1: Overview of the stakeholders of the Zurich case study and those included in the Actors' Platform

Name	*Description*	*In Actors' Platform?*
ERZ *(Entsorgung u. Recycling Zürich)*	City wastewater utility	Yes
FGZ *(Familienheimgenossenschaft Zürich)*	Housing association	Yes
Gemeinderat	City council	Partial – only one politician
Householders	Single households	No
Konsumentenforum	Consumer association	Yes
Manufacturers	Manufacturer of plumbing and water saving technologies	Yes – Geberit GmbH
SIA *(Schweizerischer Ingenieur- und Architektenverein)*	Association for Swiss engineers and architects	Yes
SSIV*(Schweizerischer Spenglermeister- und Installateurverband)*	Association for Swiss fitters and plumbers	Yes
SVGW*(Zusammenschluss von Gas- und Wasserversorgungen)*	Association for gas and water utilities	Yes
WVZ *(Wasserversorgung Zürich)*	Water supply utility	Yes

9.2.1 ERZ - Wastewater utility

ERZ is a publicly owned but financially self-supporting utility. It is responsible for wastewater disposal, wastewater treatment, waste disposal and street cleaning in the city of Zurich. The waste water treatment of Zurich purifies 90 millions m^3 of waste water every year. Its goals could be summarised as maintaining water quality through a secure waste water treatment system whilst remaining financially secure.

Worldview

Water saving may be a problem since income is dependent on water consumption, whilst fixed costs will remain. Lower water consumption also places an added pressure on transporting waste efficiently from households.

9.2.2 FGZ - Housing association

FGZ was founded in 1924 as a cooperative. Today FGZ is the second largest housing association in Zurich and owns more than 2100 apartments, which are being rented at moderate prices. Its goals are to remain financially secure.

Worldview

Housing associations own most of the housing and therefore control decision-making with respect to the installation of water saving technologies. They believe that water saving is important to reduce their bills. They are upset that there is not more competition with regards to pipe maintenance (currently WVZ has a monopoly on maintenance of pipes to houses). It would be good if there was a free market operating with regards to the repair of water systems and pipes in houses. Right now the FGZ must wait for repairs by official WVZ engineers and then has to pay high charges.

9.2.3 Geberit - Manufacturer of plumbing and water saving technologies

Geberit is a manufacturer of sanitary technology. It operates 14 factories in different countries and is an employer for more than 4200 people. In 2000 Geberit generated a revenue of € 800 millions.

Worldview

They are encouraging the use of water saving technologies and plan advertisement campaigns. New water-wasteful products could however appear. The benefit for society as a whole would be to reduce the amount of water and energy used (for heating hot water).

9.2.4 Gemeinderat - City council

The city council is the legislature of the city of Zurich. It has 125 members and is elected every four years. A right wing party, which does not like the management of the water supply, is holding 20% of the seats.

World view

They perceive the water utility to be inefficient and are not happy about current plans to expand the network further, because this will raise costs. Politicians on the right have recently used the threat of a referendum on water price rises to block the water utility's request for a price rise. There exists statutes that impel the utility to maintain a secure system (i.e. capacity > demand) at all times, in all emergencies.

9.2.5 Householders

The householders are the consumers of drinking water. 70% of them do not own their house, but rent a flat. They are influenced by politicians, by media and by their social contacts. Their goals can be summarised as maintaining the status quo, i.e. the provision of cheap, secure water of high quality.

Worldview

There is a direct democracy in Switzerland. Hence changes in the price or charging structure for water must be agreed and voted on by the public. Population is decreasing. Pressure on housing is rising as more people are living alone or in small families. Household demand is per capita over the European average. Households have a very low awareness of the water as an important issue and will only become aware of it if there are problems. There believe there are currently none. Householders demand only that there is always a secure and clean supply 24 hours a day, all year round. Householders do not get billed directly for water use, since most rent flats that have joint bills for the whole block of flats. The main decisions about water saving technology use are made by the landlords. Householders, currently, do not understand why water saving is needed.

9.2.6 Konsumentenforum - Consumer association

Konsumentenforum was founded 1961 to provide informations for critical consumers. Today Konsumentenforum does not only inform consumers, but it is also politically active with campaigns during public votes on consumer related issues. Its goals are to protect consumer interests.

Worldview

The status quo is good at the moment. For the consumers' association is it obvious that the public sees no gain to be had from water saving especially when it knows that Zürich is water rich. Perhaps with alot more information provision about the benefits of water saving, they would do it. The public has little idea about the costs of providing a water supply and wastewater treatment infrastructure. Altogether, water is no theme of relevance for the public: the supply of clean water of high quality is

assumed to be of no problem. A rise in prices or a move to a less fair pricing system would not be welcomed or understood as necessary by the public.

9.2.7 SIA/SSIV - Swiss associations for architects and plumbers

Together the two associations have about 20'000 members. The associations represent their members in political processes, are involved in the setting of technical norms and offer further education for their members. Their goals could be characterised as maintaining the reputation of the profession.

Worldview

These are associations responsible for setting norms in architect and plumbing industries. SIA and SSIV tend to think that water saving is a good thing and to be encouraged.

9.2.8 SVGW - Association for gas and water utilities

The SVGW represents gas and water utilites as well as interested groups from economy, research, science and administration. It aims to create best conditions for a secure and sustainable supply of Swiss population with gas and water.

Worldview

This is an association responsible for setting norms in the water utility industry. SVGW is sceptical about the benefits of water saving and would prefer to see a water tariff structure that reflects the costs of water infrastructure provision rather than usage. It sees the consumers' lack of awareness of water issues a problem, in that future problems and water issues are not well enough addressed in public debate leading to the possibility that society will not be well prepared should something go wrong. It sees an increase in the flow of information to the public as important.

9.2.9 WVZ - Water supply utility

The water supply of Zurich is a pubicly owned but financially self-supporting utility. It is the second largest water supply in Switzerland. Its supply area covers the city of Zurich as well as 67 partner municipalities. Thus it provides 700'000 people with

drinking water. Its goals are to maintain a high water supply security and to maintain water quality and its own financial security.

Worldview

The water utility is publicly owned but financially self-supporting. The water supply utility sees its role as providing a foundation for civilised life: clean available water. It has security of the water supply system as its top priority in terms of being able to provide water of high quality at all times. It is not, in principle, against water saving but sees water saving as endangering its ability to pay for the maintenance of the current and future infrastructure deemed necessary to maintain water security. If new decreases in demand were to continue it would need to raise its revenue somehow, either by raising prices or by charging fixed charges for the provision of the infrastructure that were independent of the amount of water consumed. Secondly, the system has about 150% over capacity with respect to average demand. If the demand falls further then water flow within the system will decrease and the risk of hygiene problems increases.The message it would like to get across to consumers is that water saving does not therefore equal money saving. Being able to smooth or break peak demand fluctuations would be a useful by-product of demand management. Then, infrastructure could be securely reduced or water sold elsewhere without fear of not being able to meet peak demand.

It believes that its hands are tied on providing more information to consumers about the non-link between water saving and money saving, since it gets only a nominal budget for information campaigns from the government. It believes it could improve the informational structure of the water bill to make the consumption/cost relationship more clear. But again they believe their flexibility is limited due to the need to get public support for actual structural changes in the bill and the fact that most customers are flat renters who only get billed for a proportion of water consumed by the whole accommodation block.

It desires to increase water supply security further by completing a integrated distribution network, the ringstollen.

9.3 Aim of Actors' Platform.

The aim of the actors' platform was to develop models to aid the stakeholders in:

- the exploration of alternative management strategies that balance the conflicting norms;
- the investigation of likely trends in consumer demand;
- the identification of institutional problems and
- in knowledge sharing, group learning and communication amongst the stakeholders.

The final output was a "memo of understanding", a document describing the individual and collective recommendations of the stakeholders about the current state of the water management system and possible future strategies for its maintenance.

9.4 Particpatory Modelling Methodology

We developed a model-building-as-learning participatory process (Lane 1992) that is tailored for stakeholder participation over a period of 3-5 years and for the group building of agent-based models (Hare et al. 2001; Hare et al. 2002; Hare & Pahl-Wostl, 2002). In our integrative approach, methods from the fields of knowledge engineering, operations research and systems dynamics are used to involve stakeholders in knowledge elicitation, model building, model validation and group learning. The process can also be described as one involving social learning that involves the development of a shared understanding of the system under consideration and management objectives, a change of attitudes and mental models and the adoption of new strategies (Pahl-Wostl, 2002).

Figure 1 shows the structure of the process. It begins with a short meeting to elicit basic problem areas in the target system, in this case, the city's water management system. Key areas of concern included predicting the future pattern of water demand so that supply capacity might be safely reduced. Then the initial knowledge elicitation phase begins to derive system concepts, stakeholders and their responsibilities. This phase includes the use of the hexagon method (Hodgson 1992) to elicit key system concepts and their relationships, and card sorting to elicit relationships between stakeholders and their interactions. The card sorting provides the first attempt to elicit agent-oriented system information. It resulted in the generation of interaction diagrams (in UML terminology) describing, for example, the way in which

stakeholders interact to improve water quality. These provide the foundation design for subsequent agent-based models.

Group discussions, based on nominal group technique (Delbecq et al. 1975), are then used to discuss with the stakeholders the results of the initial elicitation phase. Corrections are made as appropriate. Paper models in the form of structure models are then developed. These are static models depicting links between system goals, policies, measures and possible outcomes together with responsible and affected stakeholders. They allow for a limited amount of scenario analysis in terms of providing a narrative describing how goals of water saving might be obtained and what the consequences might be, as seen from the collective viewpoint of the stakeholders.

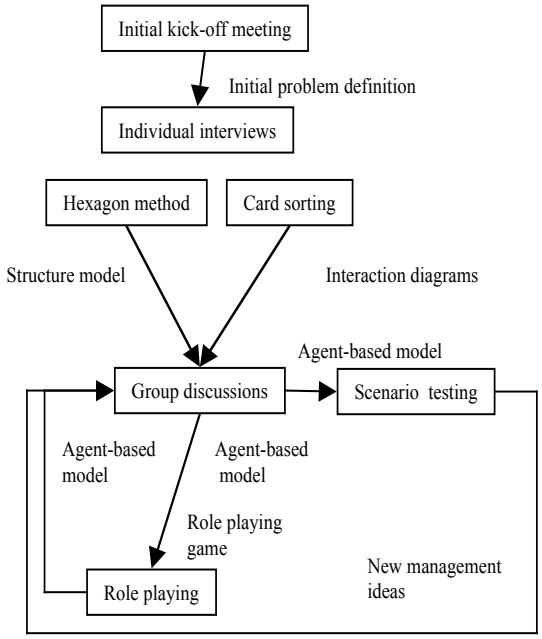

Figure 10.1: The Overview of the Participatory Modelling Methodology

From the interaction diagrams and the structure models, a computer simulation of an agent-based model is developed. This is not demonstrated to the group. Rather it is used to calibrate a role-playing game version of the model, in which agents are replaced by the stakeholders who will play the agents' roles. As in (Barreteau et al. 2001), the game is used at this stage for social learning, model validation and stakeholder acclimatisation purposes, i.e. to enhance future ownership and legitimacy of computer models. Stakeholders are also asked to take on roles that they do not normally have in the real world so that they can learn each other's perspectives of the system and gain a rare view of an abstraction of the entire system under management.

The game is additionally used for a further round of knowledge elicitation (e.g. to develop behaviour models of the stakeholders to instantiate the agent models).

The role playing game is used to allow the stakeholders to analyse their own and others' behaviour as they undertake different management roles during various city water supply scenarios. The outputs of this stage are then fed back into the group discussions. The process is iterative in that if stakeholders want to examine a scenario more thoroughly they can recreate it in the role playing game. A further option is for the stakeholders to continue the testing of scenarios with the role playing game via an internet forum. This option is described elsewhere (Hare et al. 2001).

9.5 The development of ideas during the past two years of the process

Between August 2000 and May 2002, there have been six group meetings of the stakeholders, one set of individual interviews and two questionnaires involving them and one set of focus group meetings with members of the public. The following provides an overview of the information elicited during these events and the views of the group as they have appeared over time.

Date: August 2000
Stakeholder Interaction: Group Kick-off meeting
Activity: brainstorming
No of stakeholders involved (out of 8): 6
Purpose: identify key questions to be answered about the water system in Zürich
Main Outcome: key questions asked were how to gain efficient system, what is the possible impact of water saving, how does one promote it and what do consumers want?
Theme: water saving, efficiency, what do consumers want

Date: October 2000
Stakeholder Interaction: Individual interviews
Activity: Card sorting and hexagon modelling
No of stakeholders present (out of 8): 7
Purpose: Mental model elicitation

Main Outcome: Given the priming questions: "how may consumers respond to tariff changes and water saving techonology and how can the city react?" seven mental models were elicited. A summary of the information therein is that consumers are important but they are disinterested since they are renters and water costs are opaque in bills. Technology and price may be important for determining future demand – but water saving does not equal money saving. If peaks in demand could be broken then over-capacity in infrastructure could be safely reduced. Information for the consumer is of vital importance if anything is to change in the way they behave or in how they react to water utility plans for improving security.

Theme: methods to achieve water saving; importance of information

Date: October 2000

Stakeholder Interaction: Group meeting

Activity: Discussion

No of stakeholders present (out of 8): 7

Purpose: Presentation and discussion of mental models

Main Outcome: Institutional problems hindering water saving were identified e.g. a lack of home ownership; the split between water supply and waste water services hinders awareness of true costs of water use and a lack of metering. There is also a conflict of interest between water saving, supply efficiency and income security. Finally, consumers are unaware of the benefits of water saving; consumers have not enough information. There were discussions about changing the tariff structure for water: a high fixed block price which would represent the costs of maintaining the water supply infrastructure versus a consumption-based price which would encourage water saving.

Theme: barriers to water saving; tariff schemes to support water saving in conflict with tariff schemes to support the cost of maintaining water supply security.

Date: November 2000

Stakeholder Interaction: Structured questionnaire

Activity: Private reflection and form filling

No of stakeholders involved (out of 8): 5

Purpose: Generate consensus about the most relevant factors in terms of importance to the water supply and waster water system and the ability of stakeholders to influence it

Main Outcome: The most important factors that one could easily influence included the type of billing used for water services and provision of information about water use and the provision of water saving technologies. Important but not so easy to influence were water price, infrastructure and consumer behaviour. Important but not able to be influenced were fixed costs and possible privatisation. The stakeholders considered that water saving and price elasticity were not highly important.

Theme: the importance of information and the enduring nature of fixed costs

Date: December 2000

Stakeholder Interaction: Group meeting

Activity: Scenario analysis

No of stakeholders involved (out of 8): 6

Purpose: Presentation and discussion of water saving structure-model scenario

Main Outcome: Although the WVZ rejected claims that water saving would unequivocally be advantageous for it. It was discussed how the WVZ is not against water saving per se, but the problem is that WVZ provides an infrastructure not just water. Water saving endangers finances since fixed costs are so high and enduring. A move to block charging for infrastructure rather than per unit of consumption could help match a fall in income due to water saving. However, consumers are against fixed charges, preferring personal water meters instead. There is a need to inform public what water saving brings in terms of finances and energy saving. It was noted that water must not stay more than 3-6 days in pipes or else water quality reduced. This is a further possible problem associated with water saving.

Stakeholder feedback on process: the general view was that the process was more fun, than a provider of new knowledge. However, it provides a good environment in which to meet new people. There has been a improvement in communication between stakeholders who rarely would normally meet.

Theme: The water utility provides infrastructure that needs to be paid for irrespective of consumption. Supporting the cost of maintaining water security through block charging.

Date: April 2001

Stakeholder Interaction: Group meeting

Activity: Role playing

No of stakeholders involved (out of 8): 8

Purpose: To test urban water management model of zürich as a role playing game and to use it as a focus of new discussions.

Main Outcome: The game was well received. Revisions were suggested.Water saving is not a theme for consumers – they need more information if they are to be convinced.

Theme: Role playing and consumers lack of interest in water issues

Date: September 2001

Stakeholder Interaction: Questionnaire

Activity: Private reflection and form filling

No of stakeholders involved (out of 8): 7

Purpose: Identification of stakeholders' expectations about trends in major system indicators over the next ten years e.g. water demand.

Main Outcome: Water price is expected to remain the same in the next 2 years but expected to rise in the next 10. Water demand expected to either fall or remain the same in the next 10 years. Water supply expected to remain the same in the next 2 years; and then it could stay the same or go up or down over the next 10.

Theme: much uncertainty about future supply levels; unanimity about future demand: it will not rise

Date: September 2001

Stakeholder Interaction: Group meeting

Activity: Role playing

No of stakeholders involved (out of 8): 4

Purpose: To encourage the discussion of new insights into the water system in zürich as a whole

Main Outcome: Issues raised by game included the problems of the institutional divide between the water supply and the waste water utilities; the losses incurred by the water utility due to activities, e.g. competition for sales of water saving equipment, in the private sector; and the use of taxes from the private sector to support water utilities if water saving increases. Politicians should play this game to understand the complex feedback relationship between the private and public sectors. The utilities could only survive in the game by working closely together with the politicians.

Theme: **System complexity; Institutional inadequacies; Supporting the cost of maintaining water security through taxation on the sale of water saving goods.**

Date: Jan-February 2002

Stakeholder Interaction: not involved – public only

Activity: Focus groups

No of stakeholders involved (out of 8): none, instead 8 groups of 7-11 citizens.

Purpose: Discussion of consumer attitudes towards water saving

Main Outcome: consumer knowledge of water consumption levels and price are very low; water saving is a ideological thing, not a something practical (people will want to save because they think they should. This does not mean that they will actually save water.). Reflecting the attitudes of the consumer representatives on the actors' platform, they want no fixed block pricing, preferring instead a charge based on consumption. They do not see why they should be charged a higher price for water.

Theme: **water is not an issue for consumers and it should be cheap and fairly priced.**

Date: May 2002

Stakeholder Interaction: Group meeting

Activity: Discussion

No of stakeholders involved (out of 8): 6

Purpose: Discussing the project findings so far.

Main Outcome: There was an admission that we need to know more about what the public wants – engineers had always assumed what the public needed. When we understand what the security needs of the public are then we can start discussing efficiency and water saving. The question of how to improve supply capacity efficiency was discussed. Cutting supply infrastructure was thought to be not such an effective solution due to the high fixed costs (which won't decrease in the short term if the infrastructure is reduced) and not an easy solution to carry out due to low replacement rates. Despite this one suggested from the WVZ was that maybe one could reduce the capacity of Moos when it comes to be repaired. But this is a key component of the *ringstollen*, so a reduction here would be unlikely. The alternative to cutting infrastructure is "regionalisation" – i.e. supply more water to the regions to make the system more efficient. Match the gap in finances from low water demand by selling more to the regions. This could complement a block charge tariff structure independent of consumption. But again, consumers do not think this is fair. The SVGW responded that it would be fairer for poorer families who tend to use more water.

Promoting water saving was only seen to be sensible in Zürich in terms of saving energy. Apart from considering the current state of the system and making short to medium term plans, the stakeholders also considered "Future views" of what Zürich water supply system could be like if saving money and reducing infrastructure were important. These ideas included developing 2 distribution networks: one for potable water and one for water for other uses. Money could be saved through less preparation of water in the second network. A second future view was to reduce costs of providing potable water by not providing it anymore – simply provide water for other uses only. Such ideas were not universally approved.

Stakeholder feedback on process: Our problem is that we have no urgent problem which makes it difficult to raise awareness of more complex issues to do with security and future problems.

Theme: demand management and water saving are not the primary goals. Important is to understand the public's needs for and required level of water supply security. Regionalisation not supply reduction

Date: March 2003

Stakeholder Interaction: Group meeting

Activity: Discussion and model use

No of stakeholders involved (out of 8): 6

Purpose: Discussing the problems, goals and strategies of the management system plus evaluation of the process as a whole.

Main Outcome: A new influence modelling tool was developed and used to great effect by the stakeholders to support their discussion of the strategies and their outcomes. The main strategies that interested the stakeholders were promoting water saving, regionalisation and building up security of supply. Regionalisation of the supply seemed to support the goals of increasing water supply security and to increase finances of the water utilities. It however was admitted that it did nothing to aid the goal of saving water or address the impacts of water saving, e.g. on the waste water utility and water quality.

Stakeholder feedback on process: Much was gained from participating in the process, new communication channels, context broadening discussions, new information etc. Problems existed with regards the excessive length of time between meetings and the amount of work necessary to take part. Also there was a concern that they had been encouraged into discussing water saving too much.

Theme: Regionalisation of the water supply would be a good idea, water saving is still important but problematic. The process was worthwhile, if costly.

9.6 Knowledge & its development

Section 6.5 illustrates the ebb and flow of such ideas throughout the process. There are differences of opinion amongst the stakeholders that regularly ebb and flow e.g. about the importance of water saving in this city and the need to promote water saving behaviour and technologies. There is an obvious conflict of interests between the promotion of water saving (which lowers demand) and the financial ability of the WVZ to maintain water security at current levels or to increase security by completion of the *ringstollen*. But even here, amongst the stakeholders, there is a clear trend in the direction the discussion is going. For example, the discussion about water saving went from trying to ascertain how to achieve it, to looking at the side effects of doing so in Zürich. The end result of this process, was that water saving fell

down the list of priorities to be replaced more by issues to do with developing a water supply system that meets the requirements of the public for water security and efficiency.

Many other themes arose again and again during the process. One in particular was the conflict between alternative tariff schemes for water based on paying a fixed price for the infrastructure versus paying for the water as it is consumed. The former would insulate the WVZ from the effects of water saving and also remove an incentive for doing so, whilst the latter would encourage more water saving whilst losing the WVZ income. Supporters of paying for the water consumed claimed it would be a "fair" system, in that the consumer pays. Supporters of the block charge, however, claimed that their system could be a "just" system which, apart from covering the true costs of water supply, benefits the poorest families who tend to use more water per capita.
Clearly, if water demand continues to fall, new pricing schemes need to be developed which allow the costs of maintaining such as high level of security to be supported. However, what this process has highlighted is that tariffs are a potential area of conflict between stakeholders in the city of zürich. This is a potentially difficult situation because the direct democratic principles of the city do not allow the WVZ to make decisions about tariffs in isolation. It needs the support of at least the politicians and, possibly directly, the consumers themselves through a direct vote on the issue. So whilst the WVZ may believe that it must change tariffs to maintain the water security in the city in the face of falling demand, there will be other stakeholders who will try to stop them because it contradicts their principles about water saving or fairness. This will require careful negotiation and communication between the various stakeholders, if a good solution is to be found. This relies on improved information being distributed between the parties, especially to the consumers, about the true costs of maintaining a water supply system of such high security and quality. Also the WVZ need to know more about what the consumers really want when it comes to water security and how much they want and at what price.

What is a possible solution to meeting the conflicting goals of the stakeholders? Possibly the solution lies in the virtual impossibility of reducing the capacity of the system to save costs in the medium and short term. As a result, the concept of regionalisaton becomes important. If the WVZ was to supply water to the regions to

make up for water saving behaviour in the city, then this activity could finance the high infrastructural costs whilst at the same time making efficient use of the water capacity. The WVZ could even aim to finance the completion of the *ringstollen* through regional sales. Hence the goals of water saving, financial and supply efficiency and security could be met. Block charges might not need to be imposed if enough money from regional sales could be obtained. Prices may also not have to rise.

9.7 Advantages and disadvantages of the stakeholder approach

9.7.1 Advantages

From a scientific point of view this process has allowed us to develop and test an integrated methodology for participatory modelling, policy exercises and scenario analysis. This methodology facilitates social learning, the elicitation and analysis of multiple perspectives and the group building of agent-based models through knowledge exchange and debate. We have demonstrated how we can develop a single model and use 3 implementations (computer simulation, role playing game, and internet forum) of it for different complementary tasks.

The participation of stakeholders has contributed to the building of system models that represent the breadth of the system complexity. The stakeholders have also provided continuous validation of our models and work. Agent-based approaches have provided a good way of presenting social/decision-based models to stakeholders in a way that is understandable. The use of the role playing game has presented the agent-based models in a simple acceptable format for exploring the complexity of the system from various perspectives. Models built from a participative process will be specific to a task and as a result, generic models are unlikely to appear. Instead, the methodology will be more generic.

As point out in Hare et al. (in press), one benefit of the process, has been the realisation that one can move away from high tech modelling tools, quite effectively to low tech paper models, or role playing games. In fact there are advantages in using such technologies in group work since they are easily altered and manipulable by the stakeholders and accss to them can be achieved by the whole group simultaneously.

The latter is only achievable by the use of computers, when every stakeholder has one and understands how to use it.

Participation in this process as reported by the stakeholders, has increased their understanding of the complexity of the system and their willingness to interact with each other in future. It has also led to the generation of a commonly agreed memo of understanding about the problems, goals and strategies to be employed in Zürich for use in future wider debates about water management in the city. .

9.7.2 Disadvantages

The cost of carrying out such a process in terms of time, money, resources and social interaction is enormous. Maintaining participation is a constant and exhausting problem to do with the fact that one is not dealing with scientific subjects but independent professionals who demand things in return for their participation.

The analysis of mental models is still an art, as is the complex task of verifying componentally simple but interactionally complex agent-based models. Translating the model from a role play game to an internet forum has also proved very difficult. Also, it is unclear as to whether it makes sense to combine mental models from different stakeholders into one composite. What does this composite tell us about reality or the subjective impressions of the stakeholders?

As Cooke and Kothari (2002) point out, there are three key claims of participation that sometimes do not live up to expectations in reality: that local knowledge is always good; that participation can be a force for empowerment and that the resuts of participation reflect stakeholders' desires. In this process for example, we often faced difficult problems in knowing how to weight stakeholder's often different views i.e. who to believe given contradictory statements. If all local knowledge is “good” then this would be not a problem. But local knowledge is not always good so decisions need to be made and we had little structure to help us make those decisions, particularly as we had no neutral expert to help us and relied to little on data (preferring to let the stakeholders control the input of knowledge and data into the process). It is also possible that the process did not create a new power structure amongst the stakeholders. It appeared often that those stakeholders who had dominant positions in the system when they came into the process remained just as dominant during it. The process also suffered from a lack of focus at some points in time and

overcontrol at other times. The latter is interesting since we may have introduced a strong bias towards discussing water saving and demand management ourselves, since we began the process with the not entirely accurate view that these were important issues (something that we and the stakeholders now more or less agree are not the most important for Zürich). Due to problems of dominance and over control, whether the results of the process adequately reflect the true desires or meaning of all the stakeholders is therefore hard to say.

The process lacked a neutral expert who could come in and say when the process was moving off course or not progressing anywhere. We relied too heavily on ourselves as moderators and on the stakeholders, but as can be seen from section 6.5, sometimes progress on new ideas was limited or long in coming.

The lack of an urgent problem hindered the creativity of the group and our ability to come up with focused and concrete plans. As can be seen from Figure 10.2, the number of stakeholders

varied considerably during the two years. Maintaining their interest was difficult at times. But the positive aspect of this was that we were inspired to invent the zürich water role playing game to revive their interest. Desperation can indeed be the mother of invention and inspiration, for it worked well (see Figure 10.2 for the increase in no.s for the Group 3 meeting).

9.7.3 Process Statistics

- 7 Meetings
- 10 Stakeholders
- 45 hours of discussions
- 7 mental models elicited
- 1 Agent-based model with 3 implementations
    - *2 role playing games – board game and internet version*
    - *1 Simulation Model*
- I influence model of the system
- 4 Questionnaires
- Focus group report- What do the consumers want?
- Memo of Understanding

- 1 Participatory modelling methodology

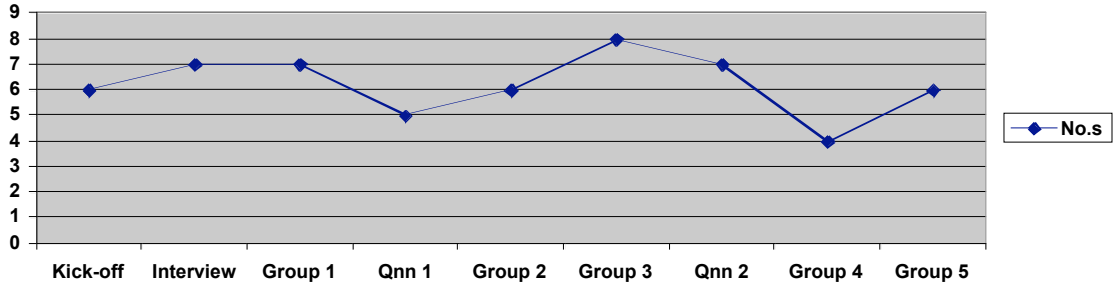

Figure 10.2. Participation figures for the stakeholders during each stage of the process (out of 9).

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10. CONCLUSION

Jörg Krywkow, ICIS; Matt Hare, EAWAG

The work description of work package 4 intended to 'develop an overall design for participation in different regions that involves the settings, schedules and stakeholders involved'. This aim could not be achieved in the original form. A uniform approach for conducting participation for any particular region in the European Union could not be identified. However, the comparison of five regional case studies revealed a number of differences as well as commonalities that reflect a variety of experiences. The identification of which may help policy makers and practitioners to realise the targets of the Water Framework Directive.

A project like FIRMA has the advantage that it can make direct comparison of case studies. This leads to a mutual learning process, not only in terms of introducing new methods, but also with respect to the various “field conditions” in the regions. Some interesting differences between the case studies are summarised here.

10.1 Comparisons between case studies

10.1.1 Culture

The impact of country-specific culture of participation and governance varies among the case studies. Switzerland has a long tradition of direct democracy, whereas in Spain established (expert) structures tend to determine decision making processes. In France and The Netherlands there exist established structures of institutions and organisations that participate in decision making processes.

10.1.2 Conflict levels

Every case study has different assumptions along a scale of **conflict**. Some problems are more urgent and have to be resolved as soon as possible for the sake of safety or basic water supply. This is the case in Barcelona and in Limburg, and to some extent in the Thames basin. Other regions have relatively luxurious problems, as in Zürich, where a surplus of water has to be managed. The urgency of a particular problem can significantly determine the level of involvement among stakeholders, and also the

interests or obligation to be involved. Usually, in the case of very urgent or even life threatening problems, governmental organisations are legally required to participate in the process. Often initiative is taken by those organisations. This is mostly a top-down process, like the case of the Maaswerken project.

10.1.3 The prior existence of Stakeholder platforms

In the Maaswerken project, a stakeholder platform was already established. The FIRMA approach was thus built upon this platform. The high costs and the time-consuming process justify an approach like that. Additionally, the issues were established, thus a new topic could not be determined without disturbing the ongoing process. The Zürich case study on the other hand was totally contrary to the Maastricht case. A stakeholder platform was created by the FIRMA-Zürich team. The issues were chosen as well as the overall participatory approach. This is clearly a bottom-up approach. The comparison of the two examples illustrates the two different aims of the case research. In the Maaswerken, an ongoing process is examined. The result is an improved set of methods towards a decision support system for future projects. In Zürich a completely new set of issues was introduced, and a new set of measures is available, in addition to participation and modelling, that might be adopted by the responsible institutions.

10.1.4 Single versus Multiple Objectives

It is obvious that an increasing number of stakeholders implies an increasing number of perspectives, which can make a participatory process even more complicated and enduring. However, the number of issues within a single case study can also increase the complexity considerably. Three of the case studies, Maaswerken, Zürich and Orb, deal with a number of problems rather than one problem. Moreover, solving a single problem can amplify another.

10.1.5 The type and use of agent-based models

As a result of the targets of the FIRMA project, the project as a whole had a clearly defined methodological framework, the combination of participatory Integrated Assessment with Agent-based modelling. Even here differences can be identified among the case studies. Some case studies developed models of simple agents. Other preferred to develop cognitively complex agents. Some of the models conducted simulations, whilst others used models as communication tools in the participatory process, especially during group processes.

10.2 Insights gained

10.2.1 ABM as representational device

In the case of the latter, one of the outstanding benefits of ABM within a participatory context is the use of the model, especially the agent architecture, as a representational device for sharing perspectives and social learning. From a methodological point of view, a cognitive agent architecture can support the representation of the concept of pluralism, views and perspectives stemming from the Integrated Assessment paradigm in a computer model.

10.2.2 Theoretical support is lacking

Another essential insight is the lack of theoretical support for applied social simulation. Whereas environmental models, e.g. hydrological approaches, have a multitude of theoretical models that can be applied in any case study within the FIRMA project. However, social simulation can only rely on a limited number of former experiences, that have often been made in unique situations. The simulation of a negotiation process contains a high degree of methodological and empirical uncertainty and vagueness. However, the principle of cognitive agents is valuable support for dealing with complex real world problems especially in negotiation situations.

10.2.3 ABM can be integrated into a participatory process

We have shown how models can be integrated into participatory IA. This holds not only for agent-based models, but also for environmental models and the combination of both. Applying agent architecture can be an effective way of clarifying stakeholder perspectives and uncertainty. The combination of ABM and participatory IA is often difficult for stakeholders to understand. At this point researchers have to be careful in explaining the method to stakeholders. However, the benefit of this approach in terms of bringing more transparency and structure in the process can be enormous.

10.2.4 Organisation's views and individual's views may differ

Useful experiences in the day to day work with stakeholders have contributed valuable insights. It was found to be crucial to distinguish between when stakeholders voice their own opinion and when they voice the opinion of the organisation they represent. This was not always done. In group sessions, sometimes emotional behaviour can take over, for example in role playing games. This, of course, is not desirable, and can distort results.

Established interest groups (e.g. consumer associations) do not always truly represent the individual members of an organisation. These groups have clearly defined interests in terms of particular issues. This must not always apply in a newly established participatory setting, especially if a new issue comes into play.

10.2.5 Stakeholders can have different roles in model development

Model building can incorporate various levels of participation depending on the issue of concern. The water supply model in Zürich was built with stakeholders, whereas the Integrated Water Model of the Maaswerken case is a purely scientific endeavour.

In the model building phase, the modeller is always in a dilemma between incorporating stakeholder concerns into the model and the analytical requirements of a scientific modelling approach. It is not always easy to find a balance.

10.2.6 Stakeholder processes incur huge costs

The time involved and the financial costs of stakeholder participation are enormous. Group meetings are difficult to co-ordinate since many stakeholders are involved in other activities. These facts have to be taken in account before setting up a long-term schedule.

10.2.7 There is tension between doing research on participation and good participatory practice

In one case study at least, Zürich, it was felt that the need to do research on methods of participation sometimes hindered the quest to produce tangible management results useable by the stakeholders from the actual participatory process. Examples of problems include the facts that sometimes methods to be tested, failed; or that concentration on the actual process was broken due to the scientific needs to develop methods and disseminate results. In future it might be recommendable to split the research teams in such case studies into methods developers and process moderators so that each goal (method development and process success) can be fairly resourced.

10.2.8 Inclusion of all the necessary stakeholders is difficult

In the Zürich case study, for example, it was necessary to get all the stakeholders including the householders onto the platform, since direct democracy meant that everyone in theory has the right to veto water management decisions through a referendum. The practical limitations of participatory modelling (and the sheer numbers of householders) meant that they could not be included in the process except through a representative of the consumers' association. The exclusion of nevertheless important stakeholders is an unfortunate fact of life for participatory processes operating in the real world. It is important that process designers take note of this and design in ways of including excluded stakeholders in some other type of role. In Zürich, for example, householder influence on the process was increased by the setting up of focus groups to measure opinion on water management. Future information campaigns were also suggested to make the communication of ideas two-way. This problem and solutions to it are further discussed in Hare et al. (in press).

10.3 Summary

A number of remarkable results have been achieved in the FIRMA project. The awareness of complex problems among stakeholders is greater. The mutual benefit of the combined approach of participatory integrated assessment and agent-based modelling has been demonstrated and gives way for projects with similar methodological and thematic ambitions. The implication of the targets of the Water Framework Directive have been tested, and a feedback in terms of regional specification was provided.

Apart from the Zürich case study, none of the processes of the FIRMA case studies is complete yet. The groups have reached various levels of participation. In most of the cases, collaboration is ongoing. In Barcelona water suppliers, users, non-governmental and governmental organisations are sitting at a table to discuss the problems of water scarcity and sustainable water supply for the first time. Some of the stakeholders have not been aware of the problem of water scarcity. Collaboration will continue far beyond the time frame of the FIRMA project.

In Maastricht collaboration between Maaswerken experts and FIRMA modellers will be continued in the project IVM (integrated investigation of the Maas), where the impact of climate change on runoff pattern of the Maas will be discussed with stakeholders, modelled and incorporated in further planning activities.

In Zürich there was a completely new stakeholder platform established, and strategies for sustainable water management under a water surplus situation have been documented. Future collaboration between stakeholders beyond the lifetime of the project is expected.

In the Orb basin, stakeholders are more aware of the conflicts of water use, especially between the tourism sector and agriculture.

The FIRMA approach can be considered as a success and can guide for both scientific approaches similar to FIRMA as well as water management projects in the future.