CHAPTER FIVE

Participation in Building Environmental Scenarios

Claudia Pahl-Wostl *

Contents

1. Introduction

Planning for the future is an important activity in environmental policy and business management. Given the complexity of today's fast changing world, it becomes increasingly difficult to extrapolate from the experiences of the past to developments in the future. Therefore scenario planning, which is already quite common in business management, is becoming more popular in environmental management and policy development.

A scenario can be defined as a plausible pathway into the future. There are different ways to assess what such a plausible pathway might be. Scenarios are a means to capture irreducible uncertainties inherent in the future development of a system. Due to indeterminacies in the behavior of human–technology–environment systems and the high complexity of many of the issues under consideration, it is

* Institute for Environmental Systems Research, University of Osnabrück, Germany

Environmental Futures: The Practice of Environmental Scenario Analysis
1574-101X.

unrealistic to expect major reductions in uncertainties due to additional scientific research. In such situations the assessment of the plausibility of future developments has to rely as much on scientific factual knowledge as on subjective judgments of experts and stakeholders. Science becomes a participant in the co-production of knowledge (Funtowicz and Ravetz, 1993; Gibbons et al., 1994; Pahl-Wostl, 1995; Pahl-Wostl et al., 1998). This role of science is of particular importance in understanding the function of stakeholder participation in environmental scenarios.

There are two compelling reasons for the participation of stakeholders (non-scientific experts) in the development of environmental scenarios:

- Participation of non-scientific experts in scenario building exercises enriches scenarios and ensures that all major uncertainties and different perspectives are taken into account.
- Participation of potential users of the scenarios (e.g. for policy development and decision making) makes it more likely that these users will indeed use the scenarios because their participation leads to shared understanding and a feeling of ownership of the scenarios.

The first type of participation is already practiced in quite a few scenario exercises. As pointed out by Alcamo (2001) (see also Chapter 6) scenarios may be qualitative and rely mainly on stakeholder imagination elicited in so-called scenario panels. In general such scenarios express development paths that are consistent within a certain worldview – so-called storylines. Scenarios may also be derived from models. Such scenarios express internal consistency with respect to the assumptions on cause-effect relationships typically made in models. Often the two approaches are combined in an interactive fashion. However, the scientific basis of these exercises is still quite weak regarding the type of knowledge to be elicited from stakeholders and the role of the scenario building exercise as part of an individual or collective learning process. The main products are the scenarios themselves that may be used to inform policy processes of different kinds.

A different approach, more in line with the second type of participation mentioned above, is the current practice of scenario planning used as strategic management tool in the business world. The Shell scenario team was a pioneering group in this field (de Geus, 1997; van der Heijden, 1996). Since scenario planning was initially developed for military purposes, it is not surprising that its early applications in the corporate world of the late 1960s and 1970s took a "prediction-command-control" approach. It was assumed that uncertainty in forecasts for the future could be captured with probabilistic estimates that fed into a process of optimal choice in decision making. But the scenario team of Shell realized that the scenarios they developed with operations research tools were often far from the mental models of executives and the real problems they were confronted with. Consequently, scenarios were often considered irrelevant by their intended users. Eventually the Shell team recognized the importance of a mutual learning process between analysts and decision makers during a scenario exercise. In his influential book "Scenarios – The Art of Strategic Conversation" van der Heijden (1996) emphasized that scenarios are foremost a product of the dialogue between people. An important product of

the scenario building exercise is the change in the mind of people who participate in it.

Approaches used in the business world cannot be directly translated to the realm of public policy because the type of interests are different and the structure of decision making is in general more complicated. But one can note a number of striking similarities to developments in the business world:

- In environmental policy and management one observes an increasing awareness of complexity and the need to change from command-and-control policies of the past to adaptive management and step-by-step learning (Pahl-Wostl, 2007a, 2007b).
- A new understanding of policy making emphasizes polycentric governance and social learning as response to the increasing complexity of society and the fast changing world in which we live (Folke et al., 2005; Pahl-Wostl et al., 2007b).

There are clear analogies to the concept of "learning organization" which is the response in the business world to similar challenges. In conclusion, it might be very rewarding to bring together the rich experience in scenario planning from the business world with current developments in participatory environmental policy and integrated environmental assessment (see Peterson et al., 2002).

This chapter will discuss the potential of, and the requirements for, participatory scenario planning as a new part of a modern approach to environmental management.

2. Polycentric Governance and Participation in Environmental Policy

Contemporary society is characterized by a widely perceived increase in complexity and difficulty of conducting public policy and decision making. Traditional top-down methods and regulatory procedures of environmental policy making have proven inadequate in dealing with socially sensitive and scientifically complex issues. Joss and Brownlea (1999) pointed out that issues of procedural justice are of paramount importance for increasing the transparency of decision making, particularly in complex, conflict-laden situations. Procedural justice refers to the fairness of the decision making process and it implies that there is a functional relationship between decision processes and outcomes. If people perceive the decision making process to be fair, it is more likely they will accept outcomes that do not support their own viewpoint, and they will develop a trustful relationship to the decision-making institution. Without such a base of communication and trust most complex environmental problems cannot be solved. A similar perspective was expressed by Minsch et al. (1998) who advocate a polycentric understanding of policy making. Minsch et al. made a comprehensive study for the German Parliament on the need for a new approach to policy making to promote sustainable development. A polycentric approach implies that policymakers will not only concentrate on attaining goals, but will also encourage processes of change. Often it is difficult to define

goals, and if they can be defined it is very uncertain whether they can be achieved. The costs and benefits of attaining goals may be controversial and highly uncertain for the different parties involved. What is even more important, the costs and benefits may depend on the process followed for achieving the goals. A polycentric approach to policy making represents a shift away from possible conflicts about goals and towards a process for social learning and designing societal change. Minsch et al. identified four basic societal strategies for social learning from a political economics perspective:

- Reflexivity.
- Compensation and conflict management.
- Innovation.
- Participation and self-organization.

A concept for social learning that is rooted in the more interpretative strands of the social sciences has been developed by the HarmoniCOP project (Pahl-Wostl, 2002a, 2002b; Craps, 2003; Bouwen and Taillieu, 2004; Pahl-Wostl et al., 2007a). Of major interest in this respect is the concept of "communities of practice" developed by Wenger (1998) which emphasizes learning as participation. Individuals engage in actions and interactions that are influenced by and may change social structure and, at the same time, the individual gains experience situated in a context. Such learning processes confirm and shape the identity of the individual in his/her social surroundings. They confirm and change social practice and the associated interpretation of the environment. One consequence of this approach is that the processing of factual knowledge cannot be seen in isolation from the social process in which it is embedded. Processes of social learning have therefore been identified to be of key importance in resources management and river basin management planning (Pahl-Wostl, 2002a, 2002b; Pahl-Wostl et al., 2007b).

One may state some goals for a social learning process that establishes the capacity of an actors' network to deal with a complex environmental problem:

- Establishment of a shared problem perception in a group of actors.
- Critical self-reflection which implies the recognition of individual mental frames and images and how they pertain to decision making.
- Recognition of mutual dependencies and interactions in an actor network.
- Engagement in collective learning- and decision-processes (new management strategies, introduction of new formal and informal rules).

The importance of social learning is a strong argument for a participatory scenario development that encourages social learning and becomes part of implementing policies. Scenarios could be linked, for example, to the implementation of river basin management policies embedded in the European Water Framework Directive. The use of scenarios in the development of river basin plans is already recommended in the Directive. But the close linkage of scenarios to environmental policy is still the exception rather than the rule. However, the increasing awareness of the impacts of climate change may strongly support the use of scenario planning. The design of policies should include scenario analyses to identify key uncertainties and to find strategies that perform well under different possible but initially uncertain future developments rather than searching for a strategy that performs optimal

under very specific conditions (e.g. climate) but performs poorly if these conditions are not met (Pahl-Wostl et al., 2007b).

The closer scenario development is linked to a formal policy process the more constraints are imposed upon the scenario process. In formal negotiation processes leading directly to binding outcomes, actors are more inclined to stick to entrenched positions rather than being open for exploratory analyses. At the same time the "stake" of stakeholders in the scenario exercise is higher, and there are better chances that the scenarios will have an impact on policy. These things have to be kept in mind in the design of a participatory process for a scenario planning exercise.

3. Designing a Participatory Process

The following section addresses some key questions that need to be addressed in setting up a participatory scenario building process:

1. **Why?** – Define the purpose of the scenario building process relative to the issue and lifecycle of the problem to be explored.
2. **For whom?** – Define the "clients" of the scenarios to be produced – Who will be affected and who should use the results?
3. **Who and when?** – Who should participate and at what stage of the scenario building process?
4. **What?** – What is the expected outcome of the participatory process and what is the role of participants? Communicate this clearly to the participating groups!
5. **How?** – Develop a "methodological culture" – It is important to build a solid knowledge base of techniques for participatory scenario building that can be tailored to the goals of the scenario exercise.

3.1 Why is the scenario building process being carried out?

A scenario building exercise may be a tool for representing the range of possible future developments in an environmental or social system that can be derived from the current state of scientific knowledge and uncertainties inherent in state of the art models. The scenarios may further feed into a scientific assessment. The scenario building exercise helps to map out the major scientific uncertainties. The IPCC emission scenarios are an example of such an approach in that they map out a range of possible future states of greenhouse gas emissions. Stakeholders may be involved in the end to judge the importance of the findings. In such cases scenarios may be used to raise awareness of an issue.

If scenarios are supposed to have a real impact on decision-making they should be closer to policy processes. Scenarios must reflect the perspectives of stakeholders. Active involvement of stakeholders already in these initial stages of the scenario building exercise is perceived to be mandatory for the success of the project.

If a scenario building exercise is mainly driven by scientific interests, the participatory process may suffer in the eyes of the stakeholders from a lack of legitimacy

and a lack of confidence in the usefulness of the results. If a scenario planning process is performed for a company or a governmental authority interested in the scenarios to support their own decision making, a lack of trust may arise within the stakeholder group in case of conflicts of interest since the process may be perceived as being biased towards the interest of one party.

3.2 For whom are the scenarios produced for?

It is obvious that the selection of participants in a scenario exercise depends on the purpose and end users of the scenarios. The end users of the scenarios could also be called "clients," a person or a group of people who trigger the project and who will be the judge of the project's success or failure and use the project's results. The client of the scenario building exercise may also be a government, an authority, the general public, and/or interest groups. A project may also have more than one client. The Water Visions exercise for example addressed a wide range of different "clients" who were supposed to use this information for their decision making (Cosgrove and Rijsberman, 2000).

An important task is to map the "action space" of the client, by establishing their "action perspective." The action space of the client may be circumscribed by mandatory rules and regulations that need to be adhered to, or by assumptions of freedom or willingness to act by the clients themselves. At this stage the issue of scale needs to be addressed. Having clarity on these points from the beginning will ensure that the results of the project will speak to the client's perceived ability to take action. Success or failure will stand or fall with aiming the outcome of the project within this space from the beginning. Aspects that may later lead to differences between the various affected/interested parties should be agreed upon in advance as much as possible. These include:

- The limitations to the exercise of power by each party.
- The willingness to be open to new and unexpected information.
- The degree to which there is tolerance for unexpected outcomes.
- The nature of participation, self-selection or membership, voluntary or mandatory.

Having established the frame of the project, the next step is to refine its objectives, if possible, together with the main clients.

3.3 Who should participate and when should they be included?

Stakeholder participation is particularly important in projects that aim to create an open-ended learning conversation and where there is no pre-judging of the nature of the outcome. In such projects stakeholders have to be carefully mapped out before participants of a participatory process are selected. Often this is done *ad hoc* – but this could lead to serious mistakes. A participatory process may suffer from an incomplete understanding of the role of different stakeholder groups. Forgetting certain groups may cause trouble as well. Therefore, it is advisable to use methods of

Table 5.1 Recommended criteria for categorizing stakeholders (adapted from Bakker et al., 1999)

Criterion	Explanation	Categories
Scale	Refers to the resolution of the stakeholders' sphere of influence	Global/national/ regional/river basin/local
Tier	Refers to whether the stakeholder has a role in planning or implementing activities in the water management system	Strategic/operational
Function	Refers to whether the stakeholder sets policy, sets regulations, or operates services in the water management system.	Policy/regulatory/ operational services
Aggregation	Refers to whether the stakeholder represents an individual or a group of individuals	Individual/collective
Thematic networks	Groupings of stakeholders with respect to a specific task	E.g. water suppliers/ water sewage managers
Policy networks	Groupings of "like-minded people that cluster around agents of action... to promote certain policies and edge out others"	E.g. anti-smoking lobby/construction industry lobby

stakeholder analysis. Different methods exist for doing so. Bakker et al. (1999) carried out a review of stakeholder categorizations that were used and recommended for water resources management. Each categorization had two parts: a criterion for dividing the stakeholders, and a list of categories into which they are grouped according to the criterion. Six general criteria and associated categories were elicited (see Table 5.1).

Another useful instrument for stakeholder mapping is the stakeholder matrix (Figure 5.1). The mapping exercise involves:

- Listing potential stakeholders.
- Classifying them according to interest and power, as per the stakeholder matrix.
- Projecting how they might move across the matrix in the future.
- Selecting the most important parties, in line with the overall frame of the project.

Apart from interest and power there may be other reasons why additional parties need to be involved. For example:

- It may be useful to involve experts and scientists who have a unique and deep understanding of aspects of the situation.
- It may also be useful to tap into new sources of creativity (the pool of "remarkable" people). This may be particularly important in situations where the scenario building process has reached a difficult phase.

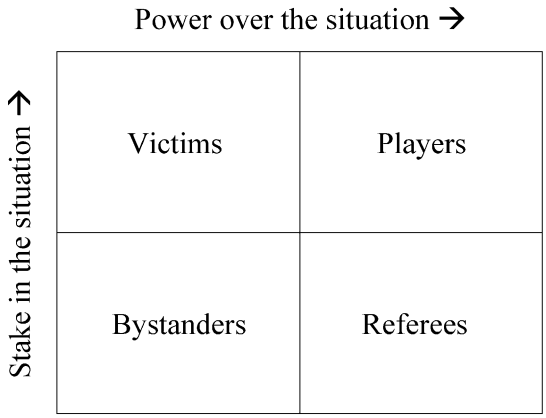

Figure 5.1 Stakeholder matrix. The different stakeholder groups are characterized according to their stake in the situation and their power to influence the decisions. "Players" have high stakes and can influence the situation – e.g. the farmers association, agricultural industry. They are crucial for the process. "Victims" need to be actively invoked to enable them to defend their interests – e.g., individual, non-organized farmers, citizens. "Referees" have power over the situation but have little stakes in the outcome. Hence they may serve as mediators, facilitators – ideally the scenario team organizes the whole process. "Bystanders" have no power and little stakes. They should not be included in the process. Based on (van der Heijden, 1996).

In many cases, it may be of importance to involve the public at large in the scenario building process. When?

- It may be useful if scenarios deal with issues of general concern where the public will provide their perception of risks and their willingness to suggested solutions.
- It may be mandatory if the goal of the scenario building exercise is to implement new management strategies that affect the public at large.

3.4 What is the expected outcome of the participatory process?

Before inviting participants of a scenario building exercise it is useful to recall expected outcomes and remember the reasons why people may be motivated to participate:

- It is mandatory.
- It is fashionable.
- The party needs support.
- The party needs data.
- The party wants to have impact.
- The party is interested in emergent learning.
- The party wishes to promote democracy.

The selection of participants affects the outcome and may carry risks that need to be considered in advance. For example, making the wrong selection may lead to:

- Over complication of the issues.
- Attempts to manipulate the project for personal ends.
- Damage to the credibility of the project because the wrong parties are associated with it.
- Feelings of rejection by those not invited.

3.5 How should the scenario exercise be carried out?

Designing the "optimal" participation is one of the crucial tasks in planning a participatory scenario exercise. Apart from the situation analysis and mapping tasks mentioned above, decisions need to be taken on many other aspects of the exercise, including:

- Timing of participation events.
- Organization of required briefings.
- Selection of appropriate language to be used to ensure effective communication.
- Selection of suitable facilitators and other personnel.
- Gaining access to specific methodological literacy in three areas:
  - Driving force analysis and scenario development.
  - Research on further systemic analysis and understanding.
  - Interaction with participants.
- Identifying the appropriate balance between narration and quantification of scenarios.
- Determining the desired level of formality in the modeling of underlying understanding.
- Creating an atmosphere akin to a "methodological culture" around the project.
- Involving the broad public in participatory processes. Different levels of public participation result in different types of involvement. One may distinguish between different forms of involvement.
- Providing information. The public gets information by leaflets, brochures, the Internet, information events, etc. This is not real participation but information is the base for any empowerment.
- Carrying out a consultation. The public gets the opportunity to give its opinion or the public's opinion is actively sought. This may be done by public hearings, the opening of scenarios – management plans to public comments, opinion polls or Internet discussions. The consultation seeks at least a response from the public. Another form of consultation may be given by citizen focus groups where the element of group discussions may lead to a broader range of outcomes. In any consultation exercise the organizing party should state clearly how the results are taken into account.
- Achieving active involvement. The public can contribute to the scenario building exercise. It shares decision-making powers in the case of implementation. The scenario building team may be interested in actively involving the public in the scenario building process and convey the results to decision makers in government and business. The type of public participation in the scenario building exercises depends largely on the overall goal of the scenario building exercise as

emphasized previously. However, it is important to define very clearly the role of the public before starting any participation.

The decision on who should participate and which methods should be used cannot be finalized until the design of the process is completed. On the other hand, the design depends on the question of who is to participate. For this reason the design may need to iterate a few times through the above process until there is a good fit between participation and design. Until this point has been reached, the designers need to keep an open mind as to who is to participate and the methods to be employed.

3.6 Exploration of different methods for participation

It is useful to consider a whole range of methods for stakeholder involvement in a scenario exercise to be able to meet the requirements of different levels of involvement of different stakeholder groups. Methods for participation may be classified according to the characteristics of the process in space and time as shown in Figure 5.2. The vertical axis refers to the difference between a participatory process proceeding at one place and time versus asynchronously. The first case could be considered a "class room" process in which participants meet face-to-face during

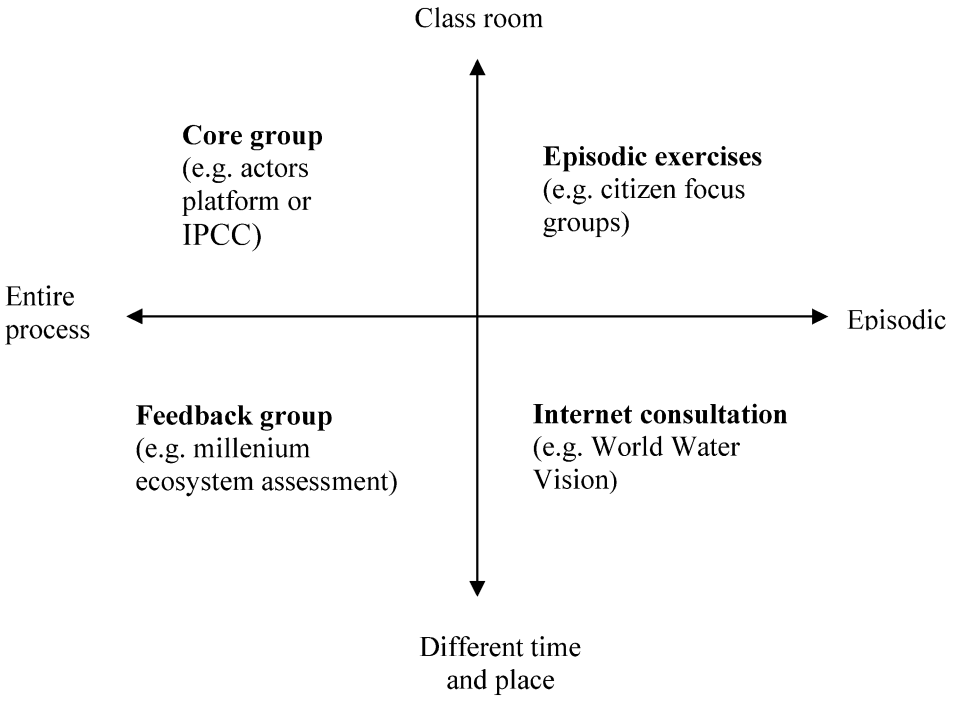

Figure 5.2 Matrix for the categorization of participation and methods according to the characteristics of the process in space and time.

a defined period of time. In the latter case participants provide their input from different spatial locations and times.

The horizontal axis refers to the duration of the participatory process, that is, if it continues over the whole period of the scenario exercise or only during short intervals. In the first case one group remains together over a prolonged time period. In the latter case participants of the process may change continuously.

3.6.1 Entire process and at one place and time

This type of participation implies the establishment of a peer group that most likely considers issues of strategic importance. It is a necessity to foster processes of social learning in a multi-party collaborative process. Trust and an improved mutual understanding must be established.

One approach to designing such a peer group is the "actors' platform" which consists of representatives from different stakeholder groups. Actors' platforms have been successfully combined with group model building and scenario exercises (Pahl-Wostl, 2002a; Hare et al., 2002). This method is ideal for the co-production of knowledge where factual knowledge is combined with subjective stakeholder perceptions in scenario development. This approach will be described in more detail in the next section.

3.6.2 Entire process and different times and places

This is more or less the philosophy underlying the SAS (Story-and-Simulation) approach as outlined by Alcamo (2001) and presented in Chapter 6 of this volume. This approach implies that a scenario panel and a modeling team are established at the start of a scenario building exercise, which is coordinated by a scenario team. The scenario panel consists of experts from science and policy. They develop qualitative storylines whereas a modeling team quantifies the scenarios. The final scenarios are developed in an iterative fashion with input from the scenario panel and individual members over the whole period. The exchange between the results from the storylines and modeling processes is not formalized. Sometimes a PSIR framework is used to structure the exchange. The development of the World Water Vision scenarios was organized along these lines. The possible developments of the state of the world's freshwater resources until 2025 were explored in three scenarios: "Business-as-usual," "Technology, economics and private sector," and "Values and lifestyles" (Cosgrove and Rijsberman, 2000).

3.6.3 Episodic and one place and time

Participation of the public is usually realized at discrete intervals and not in continuous fashion. The public may be involved to make judgments on the plausibility and acceptance of different scenarios and/or policies.

Focus groups of citizens are an important approach for public participation. The focus group methodology is widely used in public opinion research and marketing. Focus groups are designed to expose a group of people to some common stimulus. The stimulus is usually a television speech of a politician, a prototype of a new product, or some similar subject. The focus group method has been further developed for environmental research and Participatory Integrated Assessment (Dürrenberger

et al., 1999; Jaeger et al., 1999; Schlumpf et al., 1999, 2001; Pahl-Wostl et al., 2000). The discussions and social processes in a group are particularly important for the assessment of complex issues where opinion formation plays a major role. The focus group methodology allows in a well-defined setting the exploration of a range of arguments and perceptions that could arise in the informed public. This method is well suited to enrich a scenario planning exercise in its early stages and/or assess the acceptance of policy scenarios in a more advance stage of the planning process.

Scenario workshops are one example from the Danish participatory model (Andersen and Jaeger, 1999). In Denmark scenario workshops were used to arrive at decisions about technology politics. In scenario workshops, a group of citizens interacts with other actors to exchange knowledge and experience, develop common visions and produce a plan of action. A scenario derived from data/models serves as input into these discussions. The objective of one such workshop was to develop scenarios that relate sustainable development and urban ecology to the daily life of typical Danish citizens. A panel of experts and engineers developed scenarios for the daily life of a family in the year 2010. A group of citizens was confronted with these scenarios to use them as an inspiration for identifying barriers, visions and action plans for short-term options. The citizens provided their local knowledge and expertise to broaden the perspective of the scenarios. A possible disadvantage of such a local approach is difficulty in extending it to a more general level. However, it could be embedded into an overall process of developing long-term strategic visions in a multi-scale stakeholder process.

3.6.4 Episodic and different times and places

This type of approach is particularly useful for consultation processes where comments from a wide range of different actors on scenarios developed by another group are to be collected. Internet consultation is currently implemented for collecting comments from the public and stakeholder groups during the development of plans for river basin management. This is required for the implementation of the European Water Framework Directive. In consultation processes in general, participation takes place usually at the end of a scenario building exercise. Consultation does not achieve the same level of active involvement as an actors' platform or a scenario panel but has the advantage of engaging a large number of actors with limited effort.

National cultures influence how stakeholders engage in a participatory process (Enserink et al., 2007). This situation renders it somewhat difficult to make general recommendations for participatory approaches, in particular in scenario building. What may be useful in one country will be less useful in others. The importance of culture and the history of participation are particularly relevant for the design of stakeholder processes, the role of scenarios and informal aspects of decision-making in developing solutions to complex management problems.

However, it is important to recognize that the design of a participatory process requires considerable efforts and skills (Ridder et al., 2005). Hence a main recommendation is: Better no participation than participation designed without care and the appropriate methodological skills!

4. Group Model Building in Participatory Scenario Planning

The application of group model building techniques is one of the most promising approaches to promote social learning in scenario planning. One of the earliest approaches in group model building for scenario analysis was developed in management science. Consultants and practitioners realized many years ago that participatory model development was crucial for developing models that were accepted and used by clients. Lane (1992) discussed the failures of the traditional, expert consultancy approach and stated the requirements for a more suitable consultancy methodology, which makes use of "modeling as learning."

Modeling as learning has the following key aspects:

- Modeling is an integral part of management discussions.
- Consultants provide tools, which capture and express the mental models of the clients.
- Intangible "soft" issues are also considered.
- The models are owned by the stakeholders who participate in the process.
- The models are run/used and interpreted by the clients.

A major product of such an exercise is a process which enhances learning in the minds of those involved. The main advantage of such an approach is the possibility to link qualitative and quantitative aspects of dealing with a management problem. The consistency of ideas can be checked by developing common scenarios in a collective process. These coherent and consistent views of the future help the individuals involved to see which facts are closely associated and how individual frames differ.

Qualitative aspects may refer to the understanding of the complex dependencies of the system and the type of feedback processes involved which are crucial aspects of a scenario. The scenario development teams at Shell were pioneers in developing group model building based on a system dynamics approach (Lane, 1992; Vennix, 1996). This approach focuses on eliciting subjective knowledge about feedback processes and causal loops that affect system behavior and may cause unexpected effects. It is assumed that mental models about system behavior are crucial for management decisions and the rules that guide daily management practices.

One specific technique used to elicit knowledge about cause effect relationships and feedback loops is the hexagon technique (Hodgson, 1992; Vennix, 1996). The interviewer provides no structure or categories for system variables and parameters in advance. The technique may be used for individual interviews or for group model processes (i.e. nominal group technique). Individual interviews enable a comparison of the mental models of the different actors involved and the development of a coherent representation of the system. The group model building process is of major relevance to scenario development. After defining the initial problem, participants are invited to generate relevant variables in silence and write these down. After the group has finished this step, the facilitator invites group members in a round-robin fashion to name one variable from their list. Each variable is written on a magnetic

hexagon and put on a white board. After collecting variables the facilitator starts to develop causal diagrams. In an iterative process a scenario for the most important causal loops and the effects are generated. In such a process differences in individual mental frames may be lost, even though these differences are crucial for identifying potential conflicts between actors.

The exact approach to group model building depends on the goal of the scenario exercise and the availability of resources. One consideration is that individual interviews are time consuming and may not be possible with available resources. On the other hand, the group modeling approach requires getting the relevant actors around the table.

In comparison to group model building methods based on system dynamics, participatory agent-based social simulation puts more emphasis on the individual actors to be represented in the models (Pahl-Wostl, 2002a; Pahl-Wostl and Hare, 2004). Actor based analysis and modeling is a new approach for developing models in participatory settings of stakeholders. Subjective perceptions of the world are the base on which every decision is made. Knowledge elicitation techniques are used to capture the actors' subjective perceptions and expectations and implement them in the model. This allows the actors to use the model as a medium by which they can represent and reflect upon their own and others' goals, beliefs and expectations. This approach is particularly useful to understand the importance of a socially constructed reality and identify the need for cooperation to implement certain policies.

The notion of social learning implies the need to compare the "internal" (subjective mental models) and "external" (models based on factual analyses) representations of the world and expose them to interactive group discussions. The importance of mental models has been recognized for quite some time in business management (Senge, 1990; Sterman, 2001). It has not yet found widespread application in environmental decision making (Pahl-Wostl, 2002a, 2002b). Group model building allows combining formal analyses with subjective knowledge by running an approach as outlined in Figure 5.3. The figure emphasizes the two streams of knowledge that serve as input into the model and scenario building processes. Factual knowledge is derived from experimental and empirical data. Such an approach can help to improve/correct the mental models of stakeholders about processes in their system. This requires that factual scientific knowledge is established as a firm and solid base as judged by scientific practice. Furthermore, it requires an agreement among actors on the soundness of the factual knowledge that is provided by empirical analyses or modeling exercises. Finding agreement is easier for empirical data than finding agreement for results derived from simulation models. The latter contain already embedded assumptions that may be questioned. Group model building techniques may improve the sound use of factual knowledge in a stakeholder group.

Mental models may also determine and stabilize a socially constructed reality in a group. Examples are the perception of a messy problem situation, beliefs in the behavior or motives of social groups or individuals or rules of good practice shared in a group of professionals (e.g. water managers). Such mental representations shape the social exchange in a group, determine expectations and behavior. Methods to facilitate learning in such situations include behavioral simulations or group model building exercises combined with role playing games. In such gam-

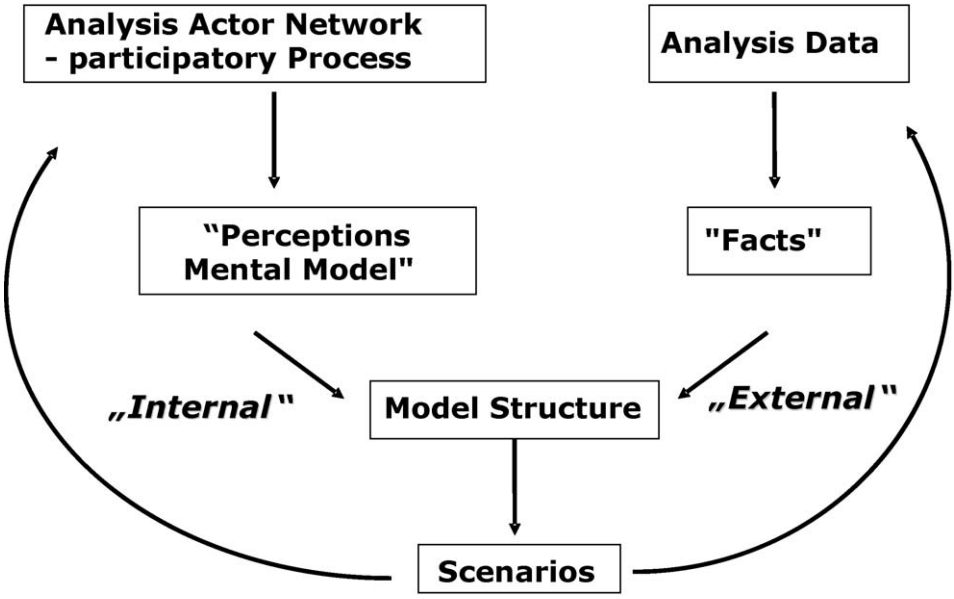

Figure 5.3 Combination of "subjective-internal" and "objective-external" analysis in actor based analysis and modeling processes.

ing approaches the social interactions between the participants are the driving force for the simulations. By adopting another role than in real life, actors may start to improve their understanding for perspectives of other actors. The games enable the participants to identify barriers and the importance of collective action and their own contributions for the realization of certain scenarios.

An actors' platform with group model building techniques and focus groups have been applied to scenario planning of urban water supply (Hare and Pahl-Wostl, 2002; Pahl-Wostl, 2002b; Pahl-Wostl and Hare, 2004). Representatives from different stakeholder groups were identified in an institutional analysis which characterized all stakeholder groups of relevance to regional water supply and water demand. Their organization, role and interactions were determined from interviews and document analysis. The platform comprised 12 members and met 8 times during a period of 18 months. An agent based model and a role playing game were developed to explore scenarios for new strategies in managing the system. The methods to elicit mental models based on systems dynamics were extended to explore the actors' perception of the social network. The method of card sorting was used to explore the subjective categorizations of the actor network and social interactions (Hare and Pahl-Wostl, 2002). The actors' platform was combined with citizen focus groups to merge different levels of decision-making and participation. Citizen focus groups consisted of 10–12 citizens and met once. A personal water demand calculator was used to investigate individual water demand and explore individual options for water saving. The group commented on possible scenarios for the overall management scheme of water supply in the city. The citizens' views on

potential future developments and their role and options for action were fed into the discussions of the actors' platform. The products of the whole process were scenarios derived from mental modeling and group model building exercise, scenarios derived from an agent based computer model, and a memo of understanding describing the various possibilities for the future development of the system (Pahl-Wostl and Hare, 2004). This example illustrates one methodology that seems to be very promising for combining formal and qualitative aspects of scenario development, and for combining scientific analyses and subjective stakeholder knowledge.

5. Conclusions

Scenario planning is a method with high potential that has not yet received a significant amount of attention in environmental policy development and resources management. This may be attributed to the fact that the tradition of resources management and of dealing with environmental problems is characterized by a command and control approach. Scenario planning and group model building techniques are quite common in business management where the prime target of management has always been the social system. However, the increasing awareness of the complexity of environmental problems and societal responses has led to increasing support of polycentric governance and has promoted the development of more flexible and adaptive management approaches (Pahl-Wostl, 2007a, 2007b). This chapter provided arguments for the role of social learning processes and the need to develop methods combining formal analysis and subjective perceptions. Participatory scenario development can support "management-as-learning" approaches and flexible policies where long-term guidance is needed for short-term decision-making. Current knowledge is sufficient to fruitfully apply the available techniques in environmental scenario planning and collect further experience that will promote progress. However, there are still some basic research challenges that need to be tackled in order to improve participatory approaches:

- Development of an improved theoretical base for the overall process in which scenario analysis is embedded (in particular, the role of individual and social learning processes).
- Categorization and comparative analysis of methods to elicit knowledge from stakeholders in participatory scenario building exercises.
- Improvement of the methodological link between stakeholder-based scenario building and model/data derived scenarios.

Dealing with these challenges will lead to an even more useful methodology of participatory scenario development.

ACKNOWLEDGEMENT

The chapter profited from the intensive and very fruitful discussions in the working group on participation in environmental scenarios during the International Workshop on Environmental Scenarios

"Scenarios of the Future: the Future of Scenarios – An international workshop on scenarios of the environment," the University of Kassel in Germany, 17–19 July 2002.

REFERENCES

Alcamo, J., 2001. Scenarios as tools for international environmental assessment. Environmental issue report No. 24. European Environment Agency, Copenhagen, Denmark.

Andersen, I.E., Jaeger, B., 1999. Scenario workshops and consensus conferences: Towards more democratic decision-making. Science and Public Policy 26, 331–340.

Bakker, K., Downing,T., Garrido, A., Giansante, C., Iglesias, E., Moral, L.d., Pedregal, B., Riesco, P., 1999. Societal and institutional responses to climate change and climatic hazards: Managing changing flood and drought risk. A framework for institutional analysis. SIRCH Working Paper, University of Oxford, Oxford, UK.

Bouwen, B., Taillieu, T., Multi-party collaboration as social learning for interdependence: Developing relational knowing for sustainable natural resource management, 2004. Journal of Community and Applied Social Psychology 14, 137–153.

Craps, M. (Ed.), 2003. Social Learning in River Basin Management. Report of workpackage 2 of the HarmoniCOP project. http://www.harmonicop.info.

Cosgrove, W.J., Rijsberman, F., 2000. World water vision: Making water everybody's business. Earthscan/Thanet Press, London, UK, 108 pp.

Dürrenberger, G., Kastenholz, H., Behringer, B., 1999. Integrated Assessment focus groups: Bridging the gap between science and policy?. Science and Public Policy 26, 341–349.

Enserink, B., Patel, M., Kranz, N., Maestu, J., 2007. Cultural factors as co-determinants of participation in river basin management. Ecology and Society 12 (2), 24 [online]. URL: http://www.ecologyandsociety.org/vol12/iss2/art24/.

Folke, C., Hahn, T., Olsson, P., Norberg, J., 2005. Adaptive governance of social-ecological systems. Annual Review of Environment and Resources 30, 8.1–8.33.

Funtowicz, S.O., Ravetz, J.R., 1993. Science for the post-normal age. Futures 25, 735–755.

de Geus, A., 1997. The living company. Harvard Business Review, 51–59.

Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P., Trow, M., 1994. The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies. Sage Publications Ltd., London, UK, 192 pp.

Hare, M., Pahl-Wostl, C., 2002. Stakeholder categorization in participatory integrated assessment processes. Integrated Assessment 3, 50–62.

Hare, M., Heeb, J., Pahl-Wostl, C., 2002. The symbiotic relationship between role playing games and model development: A case study. In: Proceedings of the 7th Biennial Conference of the International Society for Ecological Economics, Sousse Tunisia.

van der Heijden, K., 1996. Scenarios, the Art of Strategic Conversation. John Wiley and Sons Ltd., Chichester, UK, 299 pp.

Hodgson, A.M., 1992. Hexagons for systems thinking. European Journal of Operational Research 59, 220–230.

Jaeger, C., Schüle, R., Kasemir, B., 1999. Focus groups in integrated assessment: A micro-cosmos for reflexive modernization. Europ. J. Social Sci. 3, 195–219.

Joss, S., Brownlea, A., 1999. Considering the concept of procedural justice for public-policy and decision-making in science and technology. Science and Public Policy 26, 321–330.

Lane, D.C., 1992. Modeling as learning: A consultancy methodology for enhancing learning in management teams. European Journal of Operational Research 59, 64–84.

Minsch, J., Feindt, P.H., Meister, H.P., Schneidewind, U., Schulz, T., 1998. Institutionelle Reformen für eine Politik der Nachhaltigkeit. Springer, Berlin, Germany, 445 pp.

Pahl-Wostl, C., 1995. The Dynamic Nature of Ecosystems: Chaos and Order Entwined. Wiley, Chichester, UK, 280 pp.

Pahl-Wostl, C., 2002a. Participative and Stakeholder-based policy design, analysis and evaluation processes. Integrated Assessment 3, 3–14.

Pahl-Wostl, C., 2002b. Towards sustainability in the water sector: The importance of human actors and processes of social learning. Aquatic Sciences 64, 394–411.

Pahl-Wostl, C., 2007a. Transition towards adaptive management of water facing climate and global change. Water Resources Management 21 (1), 49–62.

Pahl-Wostl, C., 2007b. The implications of complexity for integrated resources management. Environmental Modelling & Software 22, 561–569.

Pahl-Wostl, C., Hare, M., 2004. Processes of social learning in integrated resources management. Journal of Applied and Community Psychology 14, 193–206.

Pahl-Wostl, C., Jaeger, C.C., Rayner, S., Schär, C., van Asselt, M., Imboden, D.M., Vckovski, A., 1998. Regional integrated assessment and the problem of indeterminacy. In: Cebon, P., Dahinden, U., Davies, H.C., Imboden, D.M., Jaeger, C.C. (Eds.), Views from the Alps: Regional Perspectives on Climate Change. MIT Press, Cambridge, UK, pp. 435–497.

Pahl-Wostl, C., Schlumpf, C., Schönborn, A., Büssenschütt, M., Burse, J., 2000. Models at the interface between science and society: Impacts and options. Integrated Assessment 1, 267–280.

Pahl-Wostl, C., Sendzimir, H., Jeffrey, P., Aerts, J., Berkamp, G., Cross, K., 2007a. Managing Change towards Adaptive Water Management through Social Learning. Ecology and Society.

Pahl-Wostl, C., Craps, M., Dewulf, A., Mostert, E., Tabara, D., Taillieu, T., 2007b. Social learning and water resources management. Ecology and Society 12 (2), 5 [online]. URL: http://www.ecologyandsociety.org/vol12/iss2/art5/.

Peterson, G.D., Cumming, G.S., Carpenter, S.R., 2002. Scenario planning: A tool for conservation in an uncertain world. Conservation Biology 17, 358–366.

Ridder, D., Mostert, E., Wolters, H.A. (Eds.), 2005. Learning Together to Manage Together: Improving Participation in Water Management. University of Osnabrück, Osnabrück, Germany. URL: http://www.harmonicop.info/HarmoniCOPHandbook.pdf.

Schlumpf, C., Behringer, J., Dürrenberger, G., Pahl-Wostl, C., 1999. The personal CO_2-calculator: A modeling tool for participatory integrated assessment methods. Environmental Modeling & Assessment 4, 1–12.

Schlumpf, C., Pahl-Wostl, C., Schönborn, A., Jaeger, C.J., Imboden, D., 2001. IMPACTS – AN information tool for citizens to assess impacts of climate change from a regional perspective. Climate Change 51, 199–241.

Senge, P., 1990. The Fifth Discipline: The Art & Practice of The Learning Organization. Bantam Doubleday Dell Publishing Group Inc., New York, 414 pp.

Sterman, J., 2001. Business dynamics: Systems thinking and modeling for a complex world. Retrieved 01.09.05 from http://www.mhhe.com/business/opsci/sterman/.

Vennix, J.A.M., 1996. Group Model Building: Facilitating Team Learning Using System Dynamics. Wiley, Chichester.

Wenger, E., 1998. Communities of practice: Learning as a social system. Systems Thinker http://www.co-i-l.com/coil/knowledge-garden/cop/lss.shtml.