# Functional design of games to support natural resource management policy development

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*This article works toward a conceptual framework for designing games to support policy development for managing natural resources. The point of departure for this framework is a typology for functions of games in support of policy. This typology consists of six classes of functions of a policy game: research and analyze policy contexts as systems, design and recommend alternative solutions to a policy problem, provide advice to a client on what strategy to follow in the policy process, mediate between different stakeholders, democratize policy development by actively bringing in stakeholder views, and clarify the values and arguments pertinent to the policy discourse. These functions are illustrated using specific examples of games that have been used in the domain of natural resource management (NRM). The framework discussed in this article may help game designers to match specific game properties (players, roles, rewards, and representations of the NRM context) with the intended function of the game in the policy-development process.*

KEYWORDS: *alternative solutions; game design; game properties; gaming; mediation; natural resource management (NRM); policy analysis; policy development; policy games; policy contexts as systems; representations; stakeholder views; strategy; rewards; roles; values clarification*

Gaming for policy purposes has a long history in the military, where strategy games have been used to explore and practice strategy (Shubik, 1975; Underwood & Duke, 1987). The period after the Second World War showed a marked increase in war gaming as a result of the rise of Operations Research, the development of game theory, the application of mathematical methods to behavioral problems, and the development of the computer (Shubik, 1975).

Gaming has a more recent history in relation to public-policy problems. When computational modeling techniques were applied to social problems in the 1960s to 1970s, these models were not very effective (Brewer, 1986; Wenzler, 1993). Formal models only represent the problem from a single perspective, whereas a gaming approach involving human players does not assume rational behavior and can take into account different perspectives on a problem (Brewer, 1986). Underwood and Duke (1987) see these features, combined with the increasing complexity of the

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institutional environment since the 1970s, as an explanation why policy games have come to be used for a broader range of applications in the last few decades. They state that by playing a strategy game, underlying objectives can become explicit, options for resolution can be tested, and actors can see the problem from different perspectives by taking on roles.

Problems in natural resource management (NRM) often involve stakeholders with different points of view. One of the well-known approaches involving stakeholders in issues regarding NRM is Adaptive Environmental Assessment and Management (Holling, 1978). This approach not only includes building a model in an interactive workshop setting, but also allows for exploring alternative scenarios through gaming with the model. Another approach that may involve gaming is the "policy exercise" approach that has been applied, for example, by the International Institute of Applied Systems Analysis to many different issues including NRM. A policy exercise is a flexibly structured process designed as an interface between academics and policy makers (Brewer, 1986; Toth, 2001).

More recent examples of gaming and NRM are proposed by Bousquet et al. (2002), who describe an approach that largely stems from work with role-playing games (RPGs) and policy exercises, and that combines multiagent systems models and RPGs for collective decision making in NRM. The cases they address involve mediation in biodiversity management processes in Madagascar, and facilitation of discussions between populations and their local representatives on decentralized allocation of land in Senegal.

These developments suggest that games are "coming of age" as tools in the hands of analysts who seek to support NRM policy development.

## Research objective and approach

Our objective in this article is to develop a conceptual framework for designing games to support policy making. The body of literature on games in general is extensive and diverse, largely because of the variety of games that have been investigated by researchers. These games range from the simplest of games such as tic-tac-toe (Salen & Zimmerman, 2004) to massive multiplayer online RPGs (Kolo & Baur, 2004; Mäyrä, 2002). The games under study have been designed for a variety of purposes (Mayer & Veeneman, 2002, p. 18). It proves to be difficult to locate and systematize the literature that is relevant for gaming as a method to support policy development. Various typologies have been introduced to map the (digital) gaming field (e.g., Aarseth, Smedstad, & Sunnanå, 2003; Klabbers, 2003). These typologies are based on the properties of games as objects. Alternatively, because games are purposefully designed artifacts, one could categorize games by their intended function, such as amusement, education, and commercial advertising.

In our effort to develop a conceptual framework for designing games to support NRM policy development, we take this function-oriented approach by considering how games can be used in different types of activities to support policy development. We base ourselves on the conceptual model we constructed earlier (Mayer, van Daalen, & Bots, 2004) to encompass the variety of styles that have been observed in

the policy-making literature. This leads to six metaphors that suggest six typical forms of policy-development support. For each metaphor, we consider how a game can provide this particular support and illustrate this with an empirical example. We then establish a link to game design by interpreting and building upon some of the ideas of Salen and Zimmerman (2004), which eventually brings us to a frame for reflection on design choices for policy-relevant games. This frame focuses first on the highest level design choice—the function the game is to perform in the NRM policy-development process—and leads from that choice to the choices relating to players, roles, rewards, and representations of the NRM context.

### Notes about terminology

- In this article we focus specifically on RPGs used in the context of policy development. Related terms to our notion of gaming are "operational gaming," "interactive simulation," or "gaming simulation."
- When we use the term "game" in this article, this implies that this game is an RPG that was specifically developed and/or used in support of a policy process. Although there is a significant body of literature about games developed for educational purposes, we disregard games that are meant solely for education and training.
- As Ståhl (1988) remarks, a game is a model, that is, a simplified representation of a decision situation, but this does not imply that a computer model or computer simulation needs to be part of a game. The games we investigate may or may not be computer-enabled.

## Functions of games related to policy

As mentioned earlier, gaming can be used for a variety of purposes in the context of policy development. To investigate the different functions of games in a structured manner, we categorize different uses of games according to the six types of policy-analysis activities in the framework of Mayer et al. (2004). This framework assumes that these activities are performed by a policy analyst (in practice this will be an analysis team rather than a single person) to enlighten his or her client, the policy maker (who can likewise be a group).

*Research and analyze.* On some policy issues the client can be advised by performing applied scientific research, because questions about facts, causes, and effects require investigation of the problem. A game can be used to research and analyze a policy issue when it is not possible to study the real system (e.g., because it does not yet exist, or it would take too long) and when it is not possible or desirable to include human behavior by way of a computer model (e.g., because the rational-actor assumption does not hold). The analyst uses the game as a *laboratory*, and playing the game is seen as an experiment that can be repeated many times to generate data and, through statistical analysis, eventually lead to generic insights.

*Design and recommend.* In some situations, designing alternative solutions to a problem and analyzing and possibly weighing the consequences of these alternative solutions can support the policy-making process. A game that functions as a virtual *design studio* can be used to enhance out-of-the-box thinking about alternative solutions to a policy problem and, when enacting solutions, also to pondering their consequences.

*Provide strategic advice.* Policy analysis can be an activity to advise the client on the most effective strategy for achieving certain goals. Provide strategic advice differs from design and recommend in that the latter addresses the substantive aspects of the policy issue, whereas the former addresses the strategic aspects of the policy process, that is, the political constellation in which the client operates, the likely countersteps of opponents, and so on. A game can serve as a virtual *practice ring* that allows the client to experiment with different strategies. In this type of game (war games being the oldest example) the other players act as sparring partners for the client: They play the role of another stakeholder as opportunistically as possible to best prepare the client for the next round in the policy process.

*Mediate.* Certain policy issues may require mediation, and a policy analyst may be asked by his or her client to act as facilitator in a process of seeking consensus between stakeholders. A mediation game can support this by putting the players around a virtual *negotiation table*. The interaction between stakeholders during the game (which is not the same as, and should not be confused with, the actual negotiation situation) can facilitate changes in attitude and/or discovery of new opportunities for conflict resolution.

*Democratize.* Experts and elites are more likely to be involved in a policy-making process, and carry greater weight than ordinary citizens and laypeople. Policy analysis can try to correct this inequality by calling attention to views and opinions typically overlooked in policy making and decision making. Games may be used as a virtual *consultation forum* that allows equal access for all stakeholders and incorporation of views and opinions that would have been disregarded in a policy process dominated by certain powerful stakeholders. An advantage of using a game rather than a conventional round-table discussion is that the game context can provide a focus and people can speak out more easily when playing a role. Also, in sensitive contexts, several games can be played with different stakeholder groups.

*Clarify values and arguments.* Implicit normative and ethical questions and opinions may have a significant influence on the policy-making process. A game can be used to clarify the values and arguments behind a point of view. An advantage of enacting a virtual *parliament* rather than having a real political debate is that the game can focus on making values explicit, whereas in political debates these tend to remain implicit. Moreover, when playing a role, positions and opinions of stakeholders can be magnified and identified more easily, and the game can be designed to reward players mainly for the quality and clarity of their argumentation.

The hexagon in Figure 1 is a simplified representation of the framework of Mayer et al. (2004) to which we have added the metaphors that express the game function for each of the six policy-analysis activities.

The dotted lines in the hexagon signify that in actual projects, the analyst supporting policy development will combine one or more activities. Taking that form is to follow function, identifying the policy-analysis activity that is to be supported is the first step in designing a game—a step that will have implications for other design choices that are to be made, as will be explained later. In the following paragraphs, we will further explain the six types of games and illustrate each with an example. Following this, the implications of these different functions will be discussed in relation to designing games.

## Research and analyze: Game as a laboratory

When a policy issue is about a social system, and system performance is largely determined by human behavior, a game can be used to investigate the aggregate

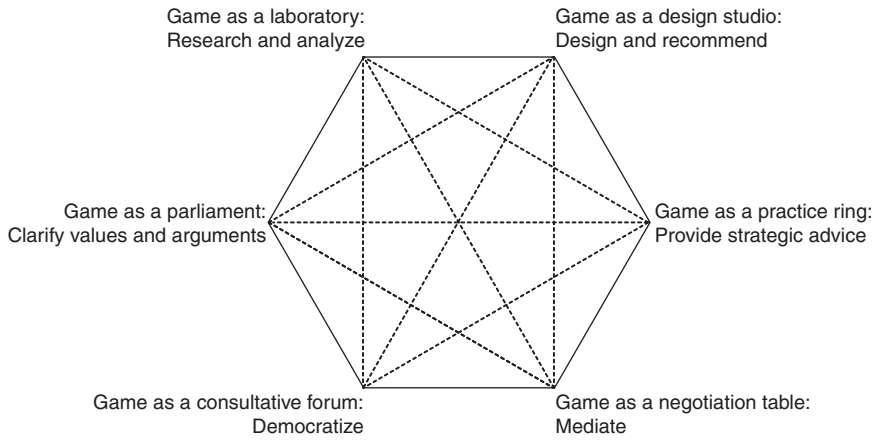


**FIGURE 1: Schematic Representation of Functions of Games for Supporting Policy Development**
NOTE: Dotted lines indicate that one or more activities are combined.

result of the actions of people within the system. Such a game could, for example, be used to investigate what the consequences would be if a particular system of emissions trading were to be introduced or how the development over time of different hydrogen technologies would be influenced by stakeholder opinions and choices.

In "laboratory"-type games the players usually are not actual stakeholders in the policy problem, but they should nonetheless have sufficient knowledge to show behavior that is representative of the actual situation. Likewise, the correspondence between the game and the NRM situation should be realistic enough to draw valid conclusions about system behavior. This may require the use of computer models. The analyst uses the game as a laboratory, and playing the game is seen as an experiment. This type of analysis is strongly connected with the field of experimental economics; see Ledyard (1995) for an overview of studies of this kind in public policy. In general, games designed to research and analyze social system behavior have to be played many times before firm conclusions can be drawn. The purpose of this type of game is not that the players learn from it—in the laboratory metaphor one might conceive of them as "white rats"—but that the analyst observing the game learns about player behavior[1] in the game. After translation of the observed behavior patterns to the real NRM situation, the analyst can advise the client. The impact of the game on the policy process will therefore be indirect.

Anderson (2004) has carried out laboratory experiments to investigate different economic institutions for tradable fishing allowance systems. The study was carried out as a result of an industry proposal to implement a tradable trap-certificate system for the Rhode Island inshore lobster fishery. Although the plan for the certificate system had been approved, the details of the trading system had not yet been determined. Experiments with two types of trading rules were carried out. The first type consisted

of the trade of a permanent allowance by means of a double auction, in which buyers and sellers can advertise a trading price. Trading can be carried out at any time and at different prices. The other type consisted of temporary leases that were exchanged through a call market in which all trades take place at the same time and price. Five double-auction and five call-market sessions were conducted with 12 to 14 participants each. The participants (Anderson uses the term "human subjects") play the role of a fisherman and interact through a computerized market. The game consisted of 12 rounds beginning with a trading stage. When the market closed participants earned a profit based on the quantity of allowance units. The double auction process, which is a commonly used system, showed that the market would be highly volatile and no equilibrium was obtained. The temporary permit experiment showed less volatility and equilibrium was obtained due to the higher quality of the price signal derived from the single-period lease market.

**Example 1: Research and analyze—Tradable fishing allowance systems**

## Design and recommend: Game as a design studio

A game can also be used to search for possible solutions for an NRM problem. Involving a variety of people in thinking about designing solutions can lead to interesting new alternatives. An example of this could be a game in which players are asked to solve the problem of nuclear waste, or a game aimed at generating innovative ideas for the spatial development of a region (Carton et al., 2002). In this situation, a game is an alternative to more conventional brainstorming and selection techniques.

The players of such a game need not be the actual stakeholders in a problem, but they should have sufficient knowledge to generate creative designs. By emphasizing particular aspects of the NRM context, the game can selectively focus on certain problem dimensions to develop tactics that in a later stage may be integrated into a complete NRM policy. A game that reduces the complexity of an NRM situation makes it easier to find feasible solutions, which may increase the players' motivation to solve the problem. Conversely, a game that increases complexity may enhance the players' awareness of the wider context of a particular NRM issue and stimulate them to search for solutions that have fewer side effects. Depending on the scope of the policy problem, it may be desirable to play a range of games to accommodate all relevant aspects. The analyst will then have to synthesize the lessons drawn from the game(s) played and report these to the client. Thus—unless the players are indeed the actual stakeholders—a "design-studio"-type game generally will influence policy indirectly through the recommendations the analyst eventually makes to the client.

Duke and Geurts (2004) describe a project that was carried out in 1993 for the International Joint Commission (IJC) on the Great Lakes. Persistent organic chemicals had accumulated in various organisms and were an environmental threat in some areas. The aim of the project was to assist the research community and policy makers in finding a strategy that provided clear options regarding environmental issues. A policy-exercise process was developed to guide discussion of policy issues for use by the IJC in preparing research priorities. An issue seminar was part of the policy exercises. In such an issue seminar all participants adopted one of seven defined perspectives (roles): physical scientist, social scientist, stakeholder, research manager, policy maker, and ecosystem philosopher. Participants had to evaluate the probability of occurrence of

certain events and the significance of these events. A structured communication process was designed as a "safe environment" to allow an open discussion of the issue. During the debriefing, real-world concerns were emphasized as the participants resolved the problem at hand. Various topics related to the great lakes ecosystem were dealt with in different runs of this exercise set-up. The first topic was the invasion of the zebra mussel, a recently introduced exotic species. For each run of the exercise, depending on the topic under discussion, the participants constituted a different mix of representatives from science, the public and the private sector (industry, non-governmental organizations, administrators) and elected government officials from both Canada and the U.S.

**Example 2: Design and recommend—Great Lakes ecosystem**

## Advise strategically: Game as a practice ring

Games can be played to develop a strategy for one particular actor in an NRM policy-development process: the client. By "strategy" in this context we mean a political plan of action: How should the client maneuver to nudge the policy process in a direction that is most favorable for him or her? By playing a "practice-ring"-type of game, the client can gain insights in the effectiveness of different strategies. A game could, for example, be designed to help an environmental conservation group develop the best response to policy makers wishing to construct a road through a preservation area. In this situation, a game is used because it is not possible to experiment in the real situation.

Except for the client, no real stakeholders are involved in the game because the insights would then lose much of their strategic value. The objective for the client role in the game is to best achieve his or her personal goals. The other players act as sparring partners for the client: they play the role of another stakeholder. They are to do this as cunningly as possible, using every means at their disposal, to best prepare the client for the next round in the policy-development process. The game should be as realistic as possible for the client to directly use the lessons drawn from the game. When the policy issue and process is open, shrewd players improvising intelligently on relatively simple role scripts that define the various stakeholder interests and resources might achieve such realism. When the policy context is strongly regulated by formal procedures (as it is in the auction setting in Example 3), or when many different scenarios need to be explored, computer models may be used. Although the analyst can still play an important role during the debriefing, the policy impact of a "practice-ring"-type game will be direct: It is the client who is informed immediately by playing the game himself or herself.

Although predominantly used to research, analyze, and design auctions for multimillion government concessions for mining, fishing, using parts of the radio spectrum, and so on, "auction games" (Csirik, Litman, Singh, & Slone, 2001) can also be used to provide strategic advice to stakeholders. A range of specialized economic consulting firms (see for example http://www.keypointconsulting.com, http://www.nera.com, and http://www.relativepath.com) offer support for clients who intend to bid on these concessions. This can be "expert support" in the sense that the consultant helps the client to develop a bidding strategy, given the often complex auctioning rules. The support can also be "pre-auction training". In this case, an auction game is used that allows bidding

teams to practice under conditions that closely resemble those of the real auction. The team members are hosted in a "war room" and go through a series of bidding rounds. Each round, they receive information on the bids of competitors as well as their own position, and have to decide on their bids for the next round. The competition may be simulated by intelligent computer agents, consultants, and (when the client group is large enough to be split up into several subgroups) other bidding teams. This hands-on simulation allows the client to get accustomed to the time pressure and excitement of an auctioning process and thus reduce the risk of clouded judgment during the real auction. Auction games can also help to provide strategic advice to the host of an auction, as the simulation with intelligent and creative human players may help to identify weak spots in the auction design before it is implemented.

**Example 3: Advise strategically—Auction games**

## Mediate: Game as a negotiation table

If for the activity of advising strategically the client is one particular stakeholder who is to outmaneuver the other stakeholders, for mediation the client is a stakeholder (usually a principal) who desires to resolve a conflict among two or more stakeholders. In such situations, the analyst could make use of a game to show to the players the possibilities for achieving consensus. The focus of a "negotiation-table"-type game is on interaction between the actual stakeholders involved in an NRM policy-development process. A game may be functional in a conflict situation because it makes stakeholders interact in a context that is different from the actual situation.

In mediation games, the actual stakeholders are to play, although not necessarily in their own role, as role reversal may lead to a better appreciation of the other parties' position (Deutsch, 1973; Lewicki, Saunders, & Minton, 1999). The interaction during the game is to facilitate changes in attitude or the discovery of new opportunities for conflict resolution. Thus, games for mediation are aimed at directly influencing those involved in an NRM policy-development process. The incentive structure of the game should be such that reaching consensus is somehow rewarded. The game must provide a "safe environment" for interaction. It is not, and should not be confused with, the actual negotiation situation, so it has to be evident that the game is an abstraction and/or deals with a fictitious case. However, it must provide participants with relevant insights for the actual negotiation situation. Games for mediation should above all facilitate the interaction between players, but this certainly does not rule out the use of information and communication technologies. Computer models may be used to calculate the consequences of player decisions, such as the costs that different parties incur when it is decided to fortify the river dikes in a particular region (Heun, Schotanus, de Groen, & Werner, 2002), but there also exist games in which the computer indicates possibilities for cooperation with other stakeholders, such as the names of stakeholders with whom it is useful to cooperate at a given moment in the negotiation process (Timmermans, 2004).

MÉÉRVISIE (Uithol, Santing, Doef, Bots, & Smallegange, 2001) is a computer-supported negotiation game that has been developed to facilitate the debate concerning the future of the IJsselmeer region in the Netherlands. The policy process of formulating a

policy vision for this region (the "wet heart" of the Netherlands) had stalled, and the primary purpose of the game was to revive it by stimulating actors to reappreciate each other's interests and capacities. Some 50 delegates from a wide range of organizations were invited to play "their" part in one of the seven role groups of the game: three decision-making groups (national government, provinces, and water boards and municipalities), two types of investors (government agencies and private enterprises), and two special interest groups (nature and environment, and economy and recreation). The participants were encouraged to bring their own knowledge and policy preferences to the table. The game objective was to develop the IJsselmeer region by investing resources in particular functions (agriculture, recreation, industry, military, flood protection, etc.). To head off detailed discussions on specific issues that at the time of the game were "hot" in the actual policy arena, the investment projects that parties could initiate, ratify, and implement in the region were fictitious yet realistic. At the beginning of the 1.5 day game, players were asked (as part of their briefing exercise) to privately reflect on their own goals as well as on the cooperation and opposition they expected from the other role groups. During the debriefing, they were asked to perform a similar reflection. Analysis of the results revealed a significant shift in attitudes toward other actors. Private investors were first viewed as "profit"-focused, but later valued as constructive partners in "people" and "planet" initiatives. Interest groups found that the support they expected from the government was not easily substantiated. The local authorities (re)discovered their mutual interest and interdependency when it comes to flood protection.

**Example 4: Mediate—MÉÉRVISIE**

## Democratize: Game as a consultative forum

Games may also be used as a vehicle for democratic decision making. Policy makers may consider the use of a game to allow equal access to an NRM policy-development process for all stakeholders and to incorporate views and opinions that are typically overlooked in policy making. An advantage of using a game in this situation, rather than a conventional round-table discussion, is that the game context can provide a focus and people can speak out more easily when playing a role. Games for democratization should represent the policy issue realistically to trigger genuine reactions. Such realism may call for the use of computer models (for example to simulate traffic flows and impacts on economy and ecology), but large maps and symbolic representations may also suffice.

To obtain the full range of views, all actual stakeholders should be involved in playing the game, and the rules of the game should stimulate a free exchange of opinions. In sensitive contexts, this could mean that several games are played with different stakeholder groups to minimize the risk of participants remaining silent because of a sense of social pressure. Games for democratization can directly inform NRM policy when resource managers and other decision makers are present or involved in the game, but the range of views and other results obtained can also be "digested" by the analyst to inform policy makers afterwards. The policy makers need not participate themselves; in some cases this might even be dysfunctional because players might feel intimidated by their presence (the game would no longer constitute a "safe environment") and not give their opinion freely. However, the policy makers should be sufficiently committed to the outcomes of the game, for if there

is no obligation whatsoever for the policy makers to take the outcomes into serious consideration, the game will not achieve its democratization purpose.

The Metropolitan Debate foundation was initiated in 1996 by six university professors from Delft and Amsterdam in the Netherlands because they were dissatisfied with the way in which decision making with regard to large projects was being conducted in the Netherlands. The Metropolitan Debate method (Frieling, 1998) aims at better, quicker, and more transparent decision making. One of the projects carried out according to the method was a series of debates about the Netherlands in 2030 that were held in 1997/1998. This series of four debates was part of the discussion that followed the publication of a white paper by the Minister of Spatial and Environmental Planning called "Netherlands 2030". The debates, endorsed by the Minister, were held in four different parts of the country and approximately 100 participants (including staff) were involved in each. The debates consisted of three phases. In Phase 1 the participants were prepared by means of a number of questions. The result was a choice of investment priorities per participants. The next two phases were part of a 1-day workshop. Phase 2 consisted of a game in which participants were assigned to a role (e.g., project developer, investor, member of an interest group). They had to take investment decisions and try to achieve their priorities by entering into alliances. This resulted in a list of projects from 2000 to 2030 and a map of the area in 2030. The final phase was a debate in which the participants judged the outcome of their decisions. As the participants were not sufficiently representative of society, the democratizing effect of the game was limited. Nonetheless, in their report to the Minister about the results of the debate and about the method, the organizers concluded that the method could improve decision making on large projects because participants can increase their judgment competences via individual preparation, creative competition, and collective consensus formation.

**Example 5: Democratize—The Metropolitan Debate**

## Clarify values and arguments: Game as a parliament

In NRM situations where normative and ethical questions are important but implicit in the political discourse, this may negatively affect the quality of the policy discourse (Fischer & Forester, 1993). A game can be used to clarify the values and arguments behind different points of view. An example of such a game could be to play a hearing in which different parties put forward their point of view on exploration of natural gas in a wetland area in front of a jury. An advantage of playing a game rather than having a political discussion in this type of situation is that the game can focus on making values explicit, whereas in the real political discourse these tend to remain implicit. Moreover, when playing a role, positions and opinions can be magnified and identified more easily.

In a hearing type of game, the topic of discussion is the actual NRM issue and the players are real stakeholders, but the game setting in which the stakeholders interact is fictitious. The game should reward players mainly for the quality of their argumentation. No computer models of the natural resource system are needed, because the focus lies on the clarification of beliefs. Instead, software tools like Decision Explorer (see http://www.banxia.com) may be used to make explicit the lines of reasoning. The players could also play in an electronic interaction environment that

simulates the context of a court of law (Maharg, 2001). As the values and arguments are clarified in the course of the game, the participating stakeholders gain insights immediately. In complex settings, additional insights gained from postprocessing the game results may be communicated by the analyst.

Developed to support a combination of policy-analysis activities, the DUBES game (Bueren et al., 2002; Bots et al., 2004) can serve as an example of the use of a game in order to clarify values and arguments. The DUBES game situates players in a setting of an urban renewal project. When played with real stakeholders, the game parameters are set to closely resemble the actual situation. The 1-day game session is divided into two rounds. In the first round, stakeholders are grouped according to which theme (e.g., mobility, livability, water, energy) correlates most with their interests. Each theme group draws up an "agenda" of the decision areas they consider most relevant for their theme. Examples of decision areas are: What types of traffic should be allowed in a neighborhood? How should streets be lit? Should there be open water, and should it be suitable for swimming or fishing? Players are provided with a "catalogue" of some 200 predefined decision areas from which they can choose, but they are free to define new decision areas or add new decision options to existing decision areas. While formulating arguments why certain decision areas are relevant and which decision options are to be preferred, the players are encouraged to bring their own knowledge and interests to the discussion. The arguments and preferences are recorded. In the afternoon session, groups are "reshuffled" to create heterogeneous stakeholder groups. Now, the objective is to achieve consensus about a program of requirements for the urban renewal project, and players are encouraged to contest each other's arguments, and eventually identify dilemmas and trade-offs. Because the focus of the game is on requirements for the project, and not on design decisions, political conflicts that may obstruct the actual decision making process are mitigated. If needed, stronger mitigation can be achieved by using a fictitious urban setting.

**Example 6: Clarify values and arguments—DUBES**

While introducing the six possible functions of games in policy development, we have mentioned a variety of conditions that should be met by a gaming exercise to be functional in the policy context at hand. In the next section, we aim to be more systematic by identifying some general game properties and investigate whether there are biases between these properties and the six functions of games in policy development.

## Implications for game design

By definition, design is a purposeful activity: The designed artifact is expected to fulfill a particular function upon being realized. Duke and Geurts (2004) repeatedly emphasize that, in game design, form should follow function. Their description of game design as a deliberate process is most thorough and complete. In this section, we therefore will not address issues related to the organization and management of the game-design process, but focus on the relation between the function of a game and certain game properties.

When a game has been designed, its actual realization consists of the game being played. Salen and Zimmerman (2004) argue that a game is "organized" play, by which they mean that this play is based on rules that limit player action. More specifically, these rules are explicit and unambiguous, shared by all players, fixed (or when dynamic, there is a set of fixed metarules that define how the rules of the game can be changed), binding (cheating is punished either by social pressure or by a referee), and repeatable (p. 125). Furthermore, Salen and Zimmerman argue that the goal of any game design is "meaningful" play. "Meaningful play is what occurs when the relationship between actions and outcomes in a game are both discernable and integrated into the larger context of the game" (p. 37).

What does this mean for the design of games to support NRM policy development? First, it suggests that the six typical functions of such games in Figure 1 may each require a different form of meaningful play: The types of action, the types of outcome, and the ways in which the game defines their relationship (in some meaningful way to the players) may have to be different. Although related, this "meaning" is not identical to the policy-relevant insights we referred to in the previous section, when we determined for each function whether these insights were inferred by the analyst and then reported to the client (research and analyze, design and recommend), obtained directly by the client and/or stakeholders while playing the game (advise strategically, mediate), or both (democratize, clarify values and arguments). Meaningful play as meant by Salen and Zimmerman refers to the idea that players make sense of the relation between actions and outcomes during the game, rather than to what players might learn from the game about anything other than the game itself. The design of a game to support NRM policy development should therefore also address the translation of meaning for players in the game to insights for stakeholders in the policy context.

Secondly, it emphasizes rules as the structuring element of a game. Indeed, the three categories that Salen and Zimmerman (2004, p. 139) use to classify rules largely determine the relation between actions and outcomes.

- *Operational* rules tell the players how to play the game. These rules are "on the outside" of the game like the levers and buttons on the outside of a machine. They make clear what decisions the players can make, what resources they have, and how they can act in the game. Operational rules could be: "When it is his turn, a player rolls a six-sided die and may then take between 0 and $N$ coins from the heap, where $N$ is the number he has rolled" and "When the heap contains fewer than 6 coins, the next player must return all of his coins to the heap and skip a turn."
- *Constituative* rules define the logical structure of the game. These rules are "inside" the game: They govern the relation between actions and outcomes insofar as these do not depend on what players do and decide amongst themselves while playing. Thus, in our example, constituative rules include the basic mathematical rules for addition and subtraction that govern the flow of coins when the two given operational rules are applied. Constituative rules do not govern social behavior. When, for example, Player 2 pleads with Player 1 (who just rolled a 6, while on the heap there are only 11 coins left) to take only 5 coins, thus sparing him or her from having to return all his or her coins, and player 1 refuses callously because, two rounds ago, Player 2 did not do the same favor for Player 3, this behavior of Player 1 is not determined by constituative rules.

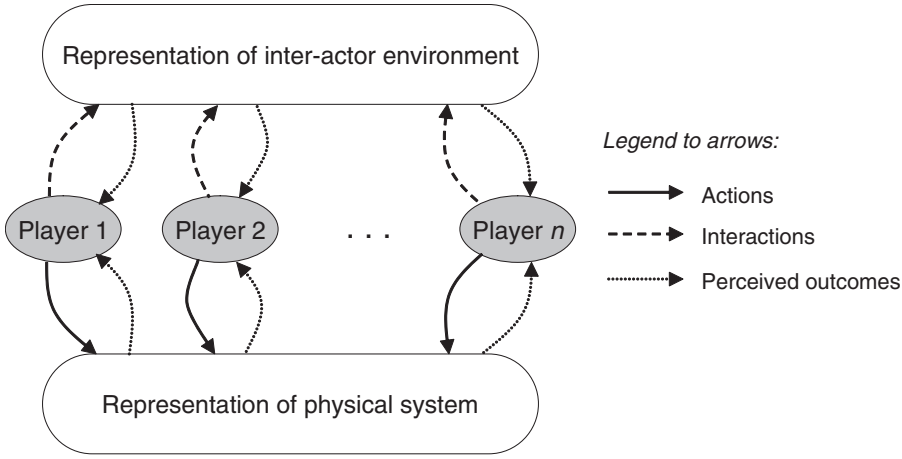


**FIGURE 2: Components of a Game for Natural Resource Management Policy Development**

- *Implicit* rules define what is proper game behavior. These rules are unwritten social norms that are largely shared by the players. In the example, these would keep players from making genuine threats of physical violence against each other.

Salen and Zimmerman (2004) make no distinction between action rules and interaction rules. We believe that when designing games to support policy making, this distinction is useful because NRM policy development is a social interaction process about some physical system (the natural resource). A game to support NRM policy could focus on the social interaction, on the physical system, or on both. The diagram in Figure 2 depicts such a game as a number of players who can *act* on a representation of the physical system (the heap of coins in our example could represent a natural resource and a player acts by taking coins from the heap) and who can *interact* in the inter-actor environment provided by the game (in our example, the players could simply be seated around a table, talking freely).

In their formulation, operational rules will often refer to the representation of the NRM context (e.g., the coins and the players), whereas the representation will often determine constitutive rules of the game (especially when computer models are used). It is not strictly necessary for a game to include both a representation of a physical system as well as a representation of an interaction environment. If the game is purely a negotiation game about obtaining a mining concession, then there will be no representation of the physical system (i.e., the mines or ore fields) and the game will just consist of the top half of the figure. If the game does not include direct interaction between players, there will be no representation of the interaction environment, and the game will just consist of the bottom half of the figure.

These observations about meaningful play and rules of the game suggest that there may be regularities in the relation between the six functions of games in policy

development and more specific game properties such as players, roles, rewards, and representations (through rules) of the NRM context. In search for patterns, we have summarized in Table 1 the game characterizations we gave in the previous section.

The "purpose" row reflects our observation about meaningful play: The activities on the left-hand side of the hexagon in Figure 1 (research and analyze, democratize, clarify values and arguments) are more oriented toward understanding the problem situation, whereas the activities on the right-hand side of the hexagon are more decision-oriented.

The next three rows show a pattern that differs from the first: The insights are obtained immediately by the real stakeholders playing themselves (i.e., a role that is close to their own position in the NRM policy context) in all functions except those at the top of the hexagon (research and analyze, design and recommend). This emphasizes the importance of the decision whether to involve real stakeholders in playing the game.

The "rewards" row also suggests a horizontal split, but here it is the two functions at the bottom of the hexagon (democratize, mediate) that deviate from the rest in the sense that the reward system in these cases should not produce winners and losers. The real stakeholders participating in the game should feel safe also in the sense that even in the game they cannot lose face. This may pose a problem for the game designer because in general the incentive for players in a game is that they like to win, and well-chosen rules for winning the game can induce players to behave in ways that are most suited to achieve the game's overall purpose. When a game is to produce no losers, the incentives must be looked for in the pleasure of playing. This pleasure may be found in the joy of making sense of something that is puzzlingly complex, or (re)discovering facts about an issue, about people, or about oneself.

The two bottom rows of Table 1 do not reveal a particular bias to function or to some of the other game properties. Contrary to our initial expectation, there is no correlation between the need for a realistic representation of the physical system and a realistic representation of the inter-actor environment. We believe this to be a particularly useful insight, because achieving good correspondence with reality tends to be a costly endeavor. A pitfall for game designers is that realism and correspondence may easily be confounded. For each of the six functions, the amount of correspondence between the game and reality that is needed to achieve the necessary sense of realism can be different. Carefully designed fictitious contexts may be excellent for clarifying values and arguments, for example. Designers should consciously deliberate where to allocate their efforts. This may be hard for those who have a hobby in achieving correspondence; games by design must focus on client needs, not on designers' hobbies.

## Combining different policy-analysis activities

Although we have presented the examples above as games that support one of the six types of policy-analysis activities, games may combine several of these types. In

**TABLE 1: Apparent Relations Between Game Properties and Function**

| | *Activities to be Supported* | | | | | |
|---|---|---|---|---|---|---|
| *Game Properties* | *Research and Analyze* | *Design and Recommend* | *Advise Strategically* | *Mediate* | *Democratize* | *Clarify Values and Arguments* |
| Purpose | Understanding | Decision making | Decision making | Decision making | Understanding | Understanding |
| Insights obtained | Indirectly, after analysis | Indirectly, after analysis | Immediately by players and indirectly after analysis | Immediately by players | Immediately by players and indirectly after analysis | Immediately by players and indirectly after analysis |
| Players | Knowledgeable people | Knowledgeable people | Client and analyst(s) | Certain stakeholders | All stakeholders | All stakeholders |
| Roles | Mixed | Mixed | Self (mixed)[a] | Self (mixed)[b] | Self | Self |
| Rewards | Reflect those in NRM situation; winners and losers | For creativity and innovation, also (but less) for feasibility; performance ranking | Reflect those in NRM situation; winners and losers | For cooperative behavior and reaching consensus; no losers | For openness and bringing new views on the issue; no losers | For quality of arguments (logical and substantive); performance ranking |
| Representation of physical system | Realistic | Variable (selective focus on dimensions) | None; focus is on the NRM policy process | Fictitious | Realistic | Realistic |
| Representation of inter-actor environment | Realistic | Fictitious | Realistic; close correspondence with actual procedures | Fictitious, and yet the game itself mediates real interaction | Fictitious | Fictitious |

NOTE: NRM = natural resource management.

a. If more than one player belongs to the client organization, some of these may play in the role of other stakeholders.

b. When role reversal is used to further better understanding of each other's stakeholder perspective.

fact, the full-scale version of the DUBES game (see Example 6 above), for instance, features a phase to clarify the values and arguments of stakeholders, followed by a phase in which "design and recommend" activities play a more dominant role. Activities need not be packaged in a single game, as it is also possible to use several different games in a single process. The case study reported by Duke and Geurts (2004; see Example 2 above) actually combined two games into one policy exercise. Prior to the issue seminar described above, the participants also play a game called the IJC philosophy game. This is an abstract game that is designed to focus on conflicting philosophical positions, making the players see and discuss the differences (clarify values and arguments) before they start with the issue seminar (design and recommend). In this way, the IJC philosophy game prepared the participants for the policy game in the second phase of the exercise. More in general, games for mediation and games for democratization both fit well in an interactive style of policy analysis (or participatory policy analysis) and can be used in combination.

A single game may also be used in different ways to support different policy activities. Originally developed for use in sylvopastoral training programs, the SYLVOPAST game (Etienne, 2003) was used in the context of NRM policy development for two different purposes. This game is about managing areas in which both trees and livestock constitute the population's livelihood. SYLVOPAST has been played repeatedly with different stakeholders to identify different NRM strategies and typical negotiating tactics (research and analyze). The game has also been played with people in management functions to achieve an improved understanding between forestry practitioners and herdsmen, by having participants play each other's role (mediate).

This double application of SYLVOPAST provides a "test case" for the relations between game properties and function proposed in Table 1: We can check for both functions whether the game has the appropriate properties. Table 2 presents an overview. Only when the game properties differed between the two uses has the corresponding row in the table been split.

The rewards and representations being identical for both functions shows that in this case the same game is indeed used for different purposes. These purposes are fairly consistent with the generic labels we used in Table 1: The analysts wish to gain understanding of the way in which shepherds and foresters negotiate about land-use planning, and to further decision making on a management plan by soothing a conflict. The same holds for the way in which insights are obtained: in the first application after analysis of game observations, in the second application immediately by the players. The players were indeed knowledgeable people:

> All those who took part in the first games had the same level of knowledge, to avoid distortions too great social or cultural disparities between them would introduce. But after some tests, the categories were mixed in order to increase the range of experiences and rationales. (Etienne, 2003, section 6.11)

As these people all were involved (as practitioner or manager) in forestry or raising sheep, they were also in a way the client of the research, hence the knowledge-transfer activity during the debriefing.

**TABLE 2: Realizing Two Functions With the SYLVOPAST Game**

| | *Activities to be Supported* | |
|---|---|---|
| *Game Properties* | *Research and Analyze* | *Mediate* |
| Purpose | "To identify the main spatial organization strategies developed and to establish a typology of the negotiating tactics used." (Etienne, 2003, section 6.7) | "To enable forestry practitioners to appreciate the constraints on herdsmen, and vice versa." (Etienne, 2003, section 6.6) |
| Insights obtained | Management strategies and negotiation tactics are identified by the analyst after analysis of a number of games. Once available, these insights are shared with players in later games during the debriefing. | As they play the game, players experience trade-offs faced by other stakeholders. |
| Players | Foresters and shepherds, some already engaged in a sylvopastoral management plan, others not (yet) involved in sylvopastoral management. | Foresters and shepherds in open conflict on a sylvopastoral management plan. |
| Roles | Foresters and shepherds play in their own role. | Reversed roles: forest managers play shepherds, and vice versa. |
| Rewards | Foresters receive credit for improving the overall performance on fire hazard, forest area, and landscape diversity. Shepherds receive credit proportional to flock size and state, which depend on grazing potential and travel distance. | |
| Representation of physical system | "The forest representation was virtual, in order to prevent local neighborhood problems from interfering with the game and to decrease possible tension between the players due to their common experience in a real case. But it was soundly realistic to make certain that the players recognized the forest as a typical Mediterranean one." (Etienne, 2003, section 2.5) | |
| Representation of inter-actor environment | "At the end of each round, foresters and shepherds have 10 minutes to negotiate an improvement of the forest and to decide to support or not the corresponding operations. The way to negotiate is entirely free and to win the negotiation the partners can use any argument. In case of disagreement at the end of the negotiation, it is the forester who has the last word." (Etienne, 2003, section 4.9)<br>"Sometimes, when negotiation was the crucial point of the game either because the game was used to assuage a conflictive situation or because the participants were trained on how to negotiate, the role of mediator was added to the game." (Etienne, 2003, section 6.3) | |

The representation of the physical system was experienced as highly realistic, even though the land-area matrix of $10 \times 10$ colored cells is highly abstract. This allows the analysts to tailor the realism to the game's function. By contrast, the SYLVOPAST representation of the inter-actor environment is not very realistic, though Table 1 suggests that for "research and analyze" it should be. Physical system properties tend to be more amenable to abstraction than social interactions. The analysts had to restrict both the number of negotiators and the time to interact to speed up the game and facilitate data capture:

> [ . . . ] asking each player to justify each of his actions in writing was abandoned, since it excessively reduced spontaneity. [ . . . ] the optimal configuration of the RPG is

2 shepherd-players facing 2 forester-players in order to oblige the players to orally express their tactics and for the observer to write them down. (Etienne, 2003, sections 6.2 and 6.12)

Table 1 suggests that for research purposes, the game could be improved in this respect. For mediation purposes, Table 1 raises more concerns. Etienne (2003) does not disclose much detail on how the game contributed to conflict mitigation. It seems to rely mainly on role reversal; the rewards and representations remain same. It may be that the rather artificial negotiation rules are favorable in a mediation setting, but there is also mention of adding a mediator role to the game when there are tensions between players.

Obviously, this application to a single case can falsify neither the validity of our framework nor establish whether the SYLVOPAST game is indeed a multipurpose game or suboptimal because of its hybrid design. However, our use of Table 1 to systematically reflect on SYLVOPAST shows that the framework we propose at least gives rise to a number of interesting questions and provokes deliberation on how the game could be enhanced to become more functional in supporting policy development.

## Conclusion

The main aim of this article has been to show that games deserve a place in the policy-analysis toolkit. Increasing problem complexity, combined with the continually increasing technological possibilities, provide new opportunities for the use of games to improve the management of natural resources. The literature (in particular Barreteau et al., 2003; Duke & Geurts, 2004; Mayer & Veeneman, 2002; Mayer & Wenzler, 2005) on the use of games in decision making shows a shift from games being produced mainly as an interesting object of inquiry ("game push") to games being designed in response to a particular need felt by actors involved in public decision-making processes ("policy pull"). Making good games may yet be more an art and craft than a science, but the game-design discipline is visibly maturing.

Convinced that games can be designed as functional tools for NRM policy development, we have tried to provide a framework to help the policy analyst to make deliberate choices in game design. The examples we have given illustrate the use of games for different types of policy-analysis activities, and our analysis suggests that the six policy-analysis activities can be used to focus the design of games to support NRM policy development. Conscious reflection on the activity to be supported by the game will lead to better design choices with regard to players, roles, rewards, and representations.

The summary of our observations in Table 1 suggests that the type of policy-analysis activity that is to be supported by the game should determine particular design choices. Evidently, Table 1 does not give deterministic rules and it cannot be read as such. Games will always require tailoring to the specific policy context. Furthermore, the last example has shown that when combining different activities

into one game or using one game for different purposes, extra care has to be taken to ensure that the game design fits the purpose. Nevertheless, crude as it yet may be, Table 1 will be helpful for analysts who consider using a game for NRM policy development, as it fosters reflection on whether the game will indeed be functional in the policy-development process.

Our capacity for formulating design guidelines may increase in the future as we collect more information on games that serve specific functions. We hope and expect that in the future games-by-design, focusing on particular (combinations of) functions in policy-development processes, will become the norm rather than the exception.

## Note

1. This general notion of player behavior includes learning behavior, which may have high relevance for the policy maker when the stakeholders repeatedly make similar decisions. See Roth and Erev (1995) for a rigorous gaming experiment of this type.

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