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The Gaming of Policy and the Politics of Gaming: A Review

Igor S. Mayer[1]

Abstract

This article examines the foundations of gaming and related concepts, such as policy exercises and serious gaming, in a public policy making context. Examining the relevant publications in *Simulation & Gaming* since 1969, the author looks back at the development of gaming simulation for purposes such as public policy analysis and planning, and reviews the underlying theories and empirical evidence. The author highlights the recognition that the success of gaming for policy making derives largely from the unique power of that gaming to capture and integrate both the technical-physical and the social-political complexities of policy problems.

Keywords

complex systems, gaming, integrated assessment, modeling, planning, policy analysis, policy exercises, policy making, policy sciences, politics, public policy analysis, serious games, simulation, social-political complexities, technical-physical complexities

Looking back at 40 years of *Simulation & Gaming* and other sources, it is indisputable that games have proven to be wonderful instruments for experimentation and learning and that gaming has been particularly useful to public policy making and public planning. Regular readers of *Simulation & Gaming* know that simulation games can be defined as *experi(m)ent(i)al*, *rule-based*, *interactive* environments, where players *learn* by *taking actions* and by *experiencing* their *effects* through *feedback mechanisms* that are deliberately built into and around the game. Gaming is based on the assumption that the *individual* and *social learning* that emerges *in* the game can be *transferred* to the world *outside* the game. This transfer is largely *negotiated* and not immediate, thereby making a simulation game low in external risks and giving the players a sense of *safety*, which is a prerequisite for *experimentation*

[1]Delft University of Technology, Delft, The Netherlands

Corresponding Author:
Igor S. Mayer, Faculty of Technology, Policy and Management, Delft University of Technology, PO Box 5015, 2600 GA Delft, The Netherlands
Email: i.s.mayer@tudelft.nl

and *creativity* (see also Abt, 1970; Shubik, 1975a, 1975b; Duke, 1974; Duke & Geurts, 2004; Geurts, Duke, & Vermeulen, 2007; Geurts, Joldersma, & Roelofs, 1998; Mayer, 2008; Mayer, Bekebrede, Bilsen, & Zhou, 2009; Mayer & Veeneman, 2002; for the negotiated effects of games, see also Juul, 2005).

For the casual observer—and most public policy makers and politicians are casual observers!—it is difficult to pinpoint why, how and what policy makers and politicians learn from gaming and how they can benefit from it. For reflective practitioners (Schön, 1983), it is rather disconcerting to see how little we actually know about the interrelation between gaming and public policy making, in terms of theory, intervention practices, and impact (see also Duke, 1998; Ryan, 2000; Thorngate & Tavakoli, 2009).[1] In other words, we hardly seem to know what happens at the interface of public policy making and gaming.

The 40th anniversary of *Simulation & Gaming* is a good occasion to explore some of the foundations for the use of gaming in a public policy context, for example, for purposes such as public policy analysis and planning.[2] I will do that primarily by reviewing the relevant articles published in the journal *Simulation & Gaming* since 1969, key papers in other journals, and several books and reports on gaming for policy analysis. The foremost question is, why use gaming for public policy making when we have so many sophisticated methods and techniques to use, from hard-core modeling and computer simulation to soft-core policy interventions, like stakeholder panels, workshops, and process management?

The outline of this article is as follows: first, I will look back at the empirical and intellectual evolution of gaming in a public policy context. In other words, I will scrutinize the bits of theory, assumptions, and arguments that seem to promote the use of gaming for public policy analysis and planning, and so on. Then I will proceed with some theorizing about what public policy making is, how it can/should be supported, and how gaming fits in.

The Evolution of Policy Gaming

In the Beginning . . .

If we accept the Von Clausewitz (1832) theorem that *war is a continuation of policy by other means*, the earliest and most common uses of policy games are so-called war games—that is, the exploration, planning, testing, and training of military strategies, tactics and operations in a simulated interactive, sociotechnical environment (Brewer & Shubik, 1979; Shubik, 1975a, in press). The long, possibly ancient history of war gaming has been recounted in many publications on war gaming and simulation gaming (see Brewer & Shubik 1979; Goldhamer & Speier, 1959; Guetzkow, Alger, Brody, Noel, & Snyder, 1963; Shubik, 1975a, 1982; see the 40th anniversary *Simulation & Gaming* review paper by Smith, in press). I will only recall that its origins are traced back to political-military gaming exercises conducted by the German and Japanese armed forces prior to World War II (see Bracken, 1977; Shubik, in press). What is omitted in most publications, however, is a deeper understanding of how war gaming (or actually the use of gaming in a political-military-security context, which is not the same) was transferred to a nonmilitary context (for a notable exception, see Mirowski, 2002). Let us examine this process in some detail.

The Emergence of Decision Sciences

First, it is important to realize that the transfer from war gaming to policy gaming did not come about through sudden impact (Becker, 1980). It was a step-by-step process of trial and error and institutional learning. During this learning process there were *heydays* of innovation, full of expectations for policy gaming, alternating with periods of stability (more of the same) or decline (with skepticism).[3]

My second observation is that this institutional learning process is part of a much wider rationalization process in public policy making, which goes back to the work of Max Weber on modernization, rationalization, and bureaucracy. This rationalization process found fertile ground just after World War II and culminated in the emergence of what came to be known as the *decision sciences*, which includes operations research (OR), systems analysis (SA), and policy analysis (PA; deLeon, 1988; House & Shull, 1991; Mirowski, 2002; Miser & Quade, 1985).

At the very root of the decision sciences we find *applied mathematics* and a variety of engineering sciences. These were used in a rather experimental fashion to support military operational planning during World War II, typically for things like the planning of convoys and bombing raids. This practice caused the emergence of a discipline named *Operations Research* in the late 1940s and 1950s (see for instance, Hillier & Lieberman, 2005). In general, OR aims to develop optimal solutions for relatively well-structured operational and logistical problems, especially in the area of (military and business) planning and management. OR generally uses methods derived from mathematics, formal modeling, game theory, decision analysis, computer simulation, and so on.

Here we find the very root of the underlying rationalization process of policy gaming, that is, the step from war gaming in a narrow sense—*the art of rehearsing for war*—to simulation gaming as a rational and analytical method for military policy making and planning. Many of the early applications of gaming-simulation in the military (in the 1940s and 1950s) were used for things such as operational logistics planning in the U.S. armed forces (see, e.g., Rauner & Steger, 1961). It also explains why the first business and management games were actually applied in the military. Classic games, such as the BEER GAME, developed by the MIT Sloan School of Management in the early 1960s, are directly derived from experiences with military logistics gaming.

In due course, OR evolved into a related discipline called *Systems Analysis* (SA; Miser & Quade, 1985; Quade, 1989). While OR mainly looked at the optimization of relatively well-structured operational planning problems, SA took up a broader, sociotechnical perspective. In general terms, it looks at the more complex behavior of systems mainly through the analysis of its interacting entities or components. SA was highly influential in the 1960s. It played a significant role in the Apollo space program and put the first man on the moon. Systems analysis was implemented by Robert McNamara (Secretary of Defense from 1961 to 1968) to make military decision making more rational (meaning economically efficient); for example, by promoting institutions like the Systems Analysis Office, and the use of quasi-formal methods for the ex ante evaluation of proposed weapon systems. In retrospect, it can be qualified as an attempt to depoliticize complex and highly political decisions.

During the 1950s and 1960s, the goal of making public decision making more rational spread throughout the American federal government in the form of another branch of the same tree, called *public policy analysis*, that is, the use of analytical methods derived from the social sciences to support public policy making and public policy makers in nondefense policy domains (see Brewer & deLeon, 1983; Dunn, 1981, 1994; Hogwood & Gunn, 1984; Mayer, van Daalen, & Bots, 2004; Parsons, 1996). A flourishing industry of think tanks emerged, with leading corporations, such as RAND, conducting significant policy and systems analysis studies and constantly innovating methods for public policy analysis (Abelson, 2004; Williams & Palmatier, 1992). Graduate programs teaching policy analysis to students and bureaucrats were established at universities. By the late 1960s and early 1970s, a profession of policy analysis had come into existence (Dror, 1967; Radin, 2002). During the 1970s, policy analysis became somewhat discredited due to the hard-felt failure of the so-called Planning, Programming, Budgeting System (PPBS) introduced in federal government. Policy analysis, however, survived the PPBS setback and is now an established professional discipline in North America and Europe (Fischer, Miller, & Sidney, 2007; Mayer, 1997, 2007; Stone & Denham, 2004).

Gaming in the Policy Analysis Toolbox

The pioneers of OR, SA, and PA were mathematicians, game theorists, physicists, and engineers. However, when these tools became used for a much wider agenda, like urban planning, health care, social policies, housing, and education, economists and social scientists took the stage. Furthermore, it was increasingly realized that military decision making took place in a political, or rather politicized, setting. We can only briefly mention Graham Allison's (1971) influential analysis of U.S. decision making during the Cuban Missile Crisis; his third model of bureaucratic politics was especially important. Such studies in the discipline of policy sciences markedly changed the prevailing views on public policy making: These were not rational and comprehensive, but political and incremental, and were later even viewed as highly erratic and volatile (Cohen, March, & Olsen, 1972; Kingdon, 1995; March & Olsen, 1989).

During the 1960s and 1970s, researchers encountered severe limitations to the formalization and computer simulation of complex policy problems (Brewer & Hall, 1973, pp. 345-366). The toolbox used by the system and policy analysts needed to become more human-centered and responsive to sociopolitical complexity. As Peter deLeon (1988) put it,

> The agnostic perspective on policy goals, the stress on optimization, the neglect of process and procedure, and the acceptance of microeconomic assumptions regarding human behavior simply proved to be inadequate bases for treating public policy issues. (p. 25)

Such forms of criticism soon led to the adoption of qualitative social science methodology in policy analysis and the adoption of interactive, less formal methods for planning, such as the scenario and Delphi methods (Dunn, 1981, 1994). The emergence of gaming simulation as an "analycentric" method for policy making was an inherent part of this institutional learning process. The interest in gaming as a method for analysis was spurred on because it proved to be extremely flexible and adaptable. In contrast to other methods, gaming could be combined easily with other more quantitative methods, such as computer simulations and scenarios. In the 1960s, systems and policy analysts therefore started modifying and developing a broad range of gaming practices and methods. Hence, a variety of gaming formats evolved, such as scenario-based gaming, simulation gaming, and seminar gaming.

The Influence of the RAND Corporation

From the late 1940s onward, think tanks such as the RAND Corporation developed and used methods for systems and policy analysis to improve the quality of governmental decision making (Abelson, 2004; Fischer et al., 2007; Stone & Denham, 2004; Williams & Palmatier, 1992). The influence of RAND—the institution and its associates—on the then-emerging discipline of gaming simulation for public policy making has been profound and wide-ranging. Martin Shubik, Harold Guetzkow, Peter deLeon, and Garry Brewer are just a few of the influential RAND analysts who contributed significantly to the development and dissemination of gaming simulation. They published several articles in the 1970s and early 1980s issues of *Simulation & Gaming* and in other journals, such as *World Politics* (Goldhamer & Speier, 1959).[4] Many of these publications were based on previous RAND reports that studied the use and usefulness of modeling, simulation, and gaming (MSG) for political-military-security policy making.[5]

Rigid and Free-Form Gaming

Because of its origin in operations research, the emphasis in military gaming initially lay on what was characterized as rigid (rule-based) gaming. This is the type of gaming that is based on a limited set of rules, usually formalized by mathematics and/or computerization.

> The rigid-form game is characterized by the prespecification of objects and rules that, taken together, determine the legitimacy of play and rigorously define the game. For many concepts and reference contexts, such prespecification is a perfectly reasonable approach. For example, a rigid form game may be derivable for some oligopolistic market settings because the structural theoretical properties are understood (Shubik, 1970). Such however is not the case for many matters in other social arenas (Brewer, 1972, p. 332).

In the 1950s, the *Social Science Division* at RAND started experimenting with a different type of gaming, which was called free form gaming, also known as seminar gaming[6] or political-military gaming. It became widely used and propagated for implementation in military and crisis management, but a little later, was also used for the consequences of a hazardous industrial facility in an urban area, and social and drug policies (Jones, 1985; Kahan, Greenwood, Rydell, Schwabe, & Williams, 1993; Kahan, Rydell, & Setear, 1996).

Although the method evolved considerably over time, free-form gaming was initially used to simulate the actions and responses of a limited set of conflicting or negotiating actors, such as two nations—for example, the United States and the U.S.S.R.—who played within the context of an initiating scenario constructed by qualified experts prior to the game. Most of all, it was considered a method for contingency planning in a context of conflict or crisis (Goldhamer & Speier, 1959; Jones, 1985; Walker, 1995). During the game play, the positions, objects, and rules were challenged, created, and improved by the players. The game was controlled and supervised by a *control team*, typically experts acting as referees or game directors (Brewer, 1978; deLeon, 1975, 1981; Jones, 1985; Shubik & Brewer, 1971, 1972). The whole process depended heavily on the subject matter expertise and experience of the players, as well as the quality of the control team and the scenario. It also allowed for minimal formalization, incomplete and incorrect information and contingency factors (natural events).

Gaming as a Science?

During the late 1960s and 1970s, military client organizations and RAND researchers seemed to lose sight of what was going on. Several RAND reports, some based on surveys in the field, were published in an attempt to give the cases, methods and experiences some coherence and to come up with conclusions about the usefulness of and prospects for gaming (see Brewer, 1975; Goldhamer & Speier, 1959; Shubik & Brewer, 1971, 1972).

Not surprisingly, several reports and *Simulation & Gaming* publications addressed the weak scientific foundations of gaming as a method for policy making and planning. Most of the experiences with gaming at the time involved education and learning, even in the military context. Guetzkows et al.'s famous INTER-NATION SIMULATION (INS), for instance, was highly successful for educational and learning purposes (Guetzkow, 1995; Guetzkow et al., 1963; Guetzkow, Kotler, & Schultz, 1972). It was used for many decades and branched into a great many games for teaching and training people in the areas of international relations and diplomacy. However, in order to be useful for policy making, some authors argued, gaming needed to be based on scientifically valid and policy-relevant theories that could be developed or tested. In other words, the value of gaming for policy making was measured against the criteria of the analytical and positivist sciences—theory based, valid, predictive, and so forth—which were still very dominant at the time (Brewer, 1978, deLeon, 1981).

Beginning in the late 1960s, a number of authors realized the need to establish the scientific foundations of gaming, mainly through a kind of *comparison by proxy*, that is, by showing the differences and similarities with related phenomena such as game theory and simulations (see Abt, 1970; Brewer & Shubik, 1979; Duke, 1974; Inbar & Stoll, 1972; Raser, 1969; Shubik, 1975a, 1975b; Taylor, 1971). The more rigid forms of gaming—mathematical, all-machine, and even the man-machine simulations—might be able to meet scientific criteria in the near future. However, in terms of usability for complex policy making, variants such as free-form gaming and all-man gaming seemed to perform much better, especially in terms of usability, client satisfaction, communication and learning and, not unimportantly, cost effectiveness.

Free-form gaming, on the other hand, was considered to be unscientific and therefore unreliable for policy making (see Brewer, 1978; deLeon, 1981). Several reasons and arguments existed for this. The outcomes of a free-form game were not replicable; it was impossible to get valid research results because observation and analysis during the game would contaminate what was being measured; and monitoring and observations during free-form gaming generated too much data, which at the time seemed impossible to manage and analyze (Brewer, 1972, deLeon, 1975 & 1981; Shubik, in press; Shubik & Brewer, 1971, 1972).

Even if gaming was still at its prescientific stage, would it ever be able to live up to the standards of normal science? If not, could it still be used for policy making and to what benefit? It could hardly be used for things like theory testing, prediction or validation. The struggle with the scientific basis of gaming for policy making is nicely illustrated in the following quote by Peter deLeon (1975) quoting Goldhamer and Speier (1959):

> Reporting on a series of games conducted by the RAND Corporation during the mid-1950s, Goldhamer and Speier (1959) noted: "we found that one of the most useful aspects of the political games was its provision of an orderly framework within which a great deal of written analysis and discussion took place." They explicitly state (1959: 78) that they did not expect, and in fact did not find, that the political game enabled them to "test strategies or to forecast political developments with any real degree of confidence." Finally, they assert (1959: 79), "the major benefit lay in the fact that the game served to suggest research priorities . . . and to define these problems in a manner that would

> make the research more applicable to policy and action requirements." Last it is important to note what these games do *not* do: they do not provide the policy maker with a predictive, operational tool (…). They do not form a theoretical construct (. . .) That an occasional scenarist can be seen in retrospect to have made accurate assumptions and predictions about future events is not, however, completely serendipitous; a skillful scenario writer may be able to postulate future events that, in retrospect, can be seen to be remarkably accurate (. . .). (deLeon, 1975, pp. 43-44)

In other words, gaming seemed different from other policy analysis methods. Perhaps other foundations and assessment criteria should be established.

Urban Planning Games

Around the 1970s, RAND analysts were broadening their scope considerably, applying their policy analytic methods, including gaming, to areas such as urban planning. Being part of the same institutional learning process and much influenced by military gaming, urban/city planners in the United States discovered gaming around the 1950s.[7] Military gamers, RAND gamers and urban gamers started to become interested in each other's work and to exchange insights. Readers who are interested in the origins and early developments of urban gaming will find a useful review in Taylor (1971) and nice personal reconstructions by Duke (1974, 1995, 2000) and Feldt (1995). From their personal accounts, we know that the first publicized games to be used for urban phenomena date back to the early 1960s, with Richard Meier, Dick Duke, and Allan Feldt as some of the founding fathers of urban gaming (see also Cecchini 1999; Cecchini & Rizzi, 2001).

Richard Meier, who then worked on natural resources management at Michigan State University, published several articles on *planning games* in *Behavioral Science* as early as 1958 (Taylor, 1971). Many of the early planning games were products of local needs developed in-house by universities or research groups, played once or twice and never published. The various U.S. and U.K. planning institutes and committees as well as educational and research institutes for planning, acted as sponsors or clients for the urban games developed at the time. The games revolved around a wide range of topics with a focus on issues such as land use, town planning, community development, public participation, city management, transportation, ecology, and natural resources. The planning scale in the games varied from local to international. Some games were more politically oriented, with participants playing citizens and interest groups; others were more managerial or technically oriented, with player roles such as administrators and planners. Although the simulation games revolved around planning and policy making, they were mainly used in an educational setting. Their impact on and use for policy making was negligible.

Unfortunately, the foundations of gaming for planning and policy making were still shaky. In a relatively short time frame, between 1969 and 1975, a series of books were published by loosely connected authors who made good efforts to lay out the scientific and disciplinary foundations of gaming. Trying to make way for gaming simulation and to get accepted, the publications were slightly propagative and apologetic. Raser's (1969) edited book *Simulation in the Social Sciences* and Clark Abt's (1970) influential title *Serious Games* were among the first, soon followed by Shubik's (1975a, 1975b) and Brewer & Shubik's (1979) publications on war gaming, Guetzkow et al.'s (1972) *Simulation in Social and Administrative Sciences*, Taylor's (1971) *Instructional Planning Systems*, and last but not least, Duke's (1974) influential *Gaming: The Future's Language*.

Requiem for Large-Scale Models

Spurred by the availability of the computer for research (still physically massive in size at the time), large-scale urban planning models (LSUMs) emerged in the early 1960s. They can best be seen as an effort to modernize planning and make the field more scientific. According to Lee (1973) they were "hypercomprehensive," trying to take into account almost unlimited kinds of quantifiable aspects, such as economics, demographics, technical factors, transportation, mobility, urban growth, and so on. However, the underlying assumptions about comprehensive rationality in policy making and planning had already been undermined by new insights, such as bounded rationality (Simon, 1957, 1991) and incrementalism (Lindblom, 1959; see also Lee, 1994, p. 35).

Duke and other gamers/planners at Michigan State University became equally fascinated by the emerging computer (Duke, 1974, 1995, 2000). Some of the urban simulation games used early versions of computer models, like Monte Carlo simulation, to simulate things like voter responses and birth, crime and building rates (Taylor, 1971, p. 42). In his personal accounts, Duke reports that he got sufficient support and funding to develop a comprehensive computer-supported simulation game about a metropolitan community, appropriately named METRO (later merged with another game into METRO-APEX). Although the simulation-game has been widely used in universities, Duke (1995, 2000) claimed that he was rather disappointed by the addition of the computer simulation part. As a result, he turned away from using computers substantially in his games.

The disappointment with comprehensive computer models for urban planning and policy making became widespread around the late 1960s and early 1970s. In 1973, Douglas Lee (1973, 1994) wrote his famous article, "Requiem for Large-Scale Models," in which he posited a number of deficiencies (sins) of modeling for planning (Lee, 1973, 1994). His tone was provocative, blaming the LSUMs among others of "grossness," "hungriness," "wrong-headedness," "mechanicalness," and "expensiveness" (Lee, 1973). Many of the LSUMs proved to be (significantly more than) a day late and a dollar short.

> [N]one of the goals held out for large scale models have been achieved, and there is little reason to expect anything different in the future (. . .) Methods for

> long range planning—whether they are called comprehensive planning, large scale systems simulation, or something else—need to change drastically, if planners expect to have any influence on the long run. (Lee, 1973, p. 163)

According to Lee (1973, 1994), the problem was fundamental and mainly because of the limitations of computer modeling and the naiveté of modelers about the world of politics and planning. Studies from political science, management science, and organizational behavior had recently demonstrated that policy making was *not* comprehensive, rational, and linear, but rather bounded, political and incremental (Allison, 1971, Lindblom, 1959; Simon, 1957, Wildavsky, 1979). In his criticism of urban modeling, Lee was especially skeptical about the use of urban planning models for gaming:[8]

> This is perhaps the *ultimate comedown* [italics added], as it means using the models as heuristic aids in the context of operational gaming. Players make decisions in the synthetic city, observe the consequences and make new decisions. (Lee, 1973, p. 171)

The Science–Public Policy Interface

Lee certainly was not alone in his criticism of the use of modeling, simulation, and gaming (MSG) for policy making (for a fundamental criticism on MSG for policy making at RAND, see Mirowski, 2002). In an unusually critical tone, RAND analyst Garry Brewer (1975) wrote a report on the uses and abuses of modeling, simulation and gaming for decision-making, especially in the area of defense and security. Based on his own experiences and surveys, Brewer (1975) observed,

> [C]lose inspection (. . .) reveals a divergence of purpose between those who build and those who use MSGs having a policy assisting intent; users are inadequately trained to know what they are buying from technical experts; and this inadequacy also exists with respect to the experts knowing or caring about the users. What results are ill-developed controls over the building and use of MSGs because (1) the actual users do not know how the information contained in the model was generated; and (2) the experts responsible for the information contained in the model have abnegated responsibility for the products through disinterest, contempt, and ignorance. (p. iii)

Brewer and others pinpointed the many perverse mechanisms behind MSG for policy making, such as the use of MSG to defer or stall decisions, as pure advocacy or as “science for effect”:

> Many of the people in the US departments of Housing and Urban Development and Health, Education, and Welfare, who are directly responsible for the

> millions of dollars that have gone into some of the public sector models, simulations, and games, really could not care less what those MSGs produced as long as they, the research sponsors, got credit for having been modern, management-oriented and scientific. (Brewer, 1975, p. 3)

There proved to be insufficient countervailing mechanisms due to “pervaded client-analyst relationships,” “internal bureaucratic fights,” a “Think Tank industry that was wise enough not to bite the hand that feeds it,” “decision makers far removed from the fonts of analytical wisdom” and “a lack of independent and critical reviews and evaluations of MSG.” In other words, “if one has a big machine and a lot of bright machinists, they must be kept busy” (Brewer, 1975, p. 3).

However, more fundamental epistemological, political and ethical questions were at stake. The interface between science (policy analysis, MSG) and public policy making itself was problematized at a time when traditional beliefs and values and vested authorities were being challenged. It became an area of scientific investigation (Jasanoff, 1990; Hoppe, 1999).

The so-called *utilization of knowledge* school developed several theories about the use of social scientific research and knowledge (or the lack thereof) in policy making. Caplan (1979), Weiss (1977), Weiss and Bucuvalas (1980), and Dunn (1980), for instance, argued that scientists and policy makers were operating in separate communities and that many communication barriers existed between them. Weiss (1977), Dunn (1980), and others described several models of the utilization of knowledge for policy making: a *political model*, where research is used to confirm predetermined positions, that is, for legitimization; a *tactical model*, where research is mainly used as political ammunition; an *enlightenment model*, where research sensitizes the makers of public policy and the general public to new issues, if necessary in a critical way; an *intellectual model*, where social science research and policy influence each other as part of a larger, longer-term learning process (compare with policy oriented learning, Sabatier & Jenkins-Smith, 1993).

Jasanoff (1990) and others started to develop a social-constructivist view on science for policy making. In their view, scientists were stakeholders with social, personal and political interests and values, and research for policy making is a social-constructive process, of interaction and learning among stakeholders, experts, politicians, or scientists alike. It considerably affected the thinking about the role of MSG for policy making.

Gaming and Communication

From the 1970s to date there has been a steady flow of innovation in computer support for policy making and planning: system dynamics (SD), agent-based models (ABMs), cellular automata (CA), decision support systems (DSS), and geographical information systems (GIS; Cecchini 1999; Cecchini & Rizzi, 2001; Lee, 1994). In response to the aforementioned criticism, some modelers simply tried to make their modeling or simulation technologies better, that is, faster, cheaper, more detailed and refined, and with more fidelity and validity. Others turned away from quantitative models altogether and started to promote the use of *soft systems* and *conceptual mapping techniques* (Checkland 1999; Eden & Ackermann, 1998; Vennix, 1996). Donella Meadows and Jennifer Robinson (1985, 2002) investigated the impact of systems analysis and computer modeling, particularly as applied to social policy. Based on a study of nine models, the authors concluded that

> The main impact was on a vital but immeasurable part of the system: the world of ideas. The models legitimized, publicized, opposed, or made concrete some major old or new ways of thinking about the systems we live in. They enhanced the mental models of the modelers; they were clear reminders that the world is complex. They contributed to the debate; they did not end it. (Meadows & Robinson, 2002, p. 276)

The third and most common strategy therefore was to open up the black box of quantitative models and to make them much more responsive and suitable for complex policy making. This was done by making the computer models much more transparent, easier to use and interactive, so that they could be used for stakeholder participation, communication and policy-oriented learning. Meadows and Robinson (2002), for instance, developed a number of guidelines for improvement, such as rough prototyping, involving the client in the model building process, experiencing the system, and so on. At the same time, they urged modelers to be critical and to transform their modeling practices, because the social systems they were studying were "in deep trouble" (Meadows & Robinson, 2002, p. 290).

The methodology of gaming was seen as the most appropriate candidate for designing computer-mediated interaction among policy stakeholders. Gaming could provide insights into how to arrange an experimental context with players, roles, rules, and a scenario. In other words, Lee's "comedown" was transformed into a triumph: a hard core of whatever the computer model incorporated in a soft shell of gaming (usually through some form of role-play). The wider availability of computer and simulation technology further enabled the development of computer-supported simulation games.

Furthermore, the design process of models and simulations was opened up, with different methods for stakeholder and user interaction. In the process of designing a computer model, gaming could also play a role. In the Netherlands, Geurts and Vennix (1989, see also Vennix & Geurts, 1987) developed a methodology of participative modeling, with gaming at the top of the hierarchy. Heavily influenced by the Michigan school and by Duke's notion of "multilogue," Geurts et al. (2007) claimed that the policy relevance of gaming should be based on five Cs: complexity, communication, creativity, consensus, and commitment to action. Most of all, gaming should be seen as a "language of complexity" (or "Gestalt," Crookall & Thorngate, 2009; Duke, 1974; Vennix & Geurts, 1987). The formal and mathematical approach to gaming for policy analysis that commenced with OR was now under the strong influence of social-constructivism, if not semiotics, psychologism, or rhetoric (Thorngate & Tavakoli, 2009). Unfortunately, social constructs such as "multilogue," "communication," and "commitment to action" seemed impossible to operationalize, let alone evaluate empirically in a policy context.

The Influence of System Dynamics on Planning and Policy Games

Worth mentioning and very relevant to the evolution of policy gaming is the close connection between gaming and system dynamics. Developed in the early 1960s as industrial dynamics by Jay Forrester (1969, 1971), system dynamics is a powerful approach to modeling and understanding the long-term behavior of complex dynamic systems. Among other things, it demonstrates how self-reinforcing and self-mitigating feedback loops can cause surprising and counterintuitive effects over time. Around 1969, Jay Forrester applied system dynamics to cities and metropolitan areas in *Urban Dynamics*.

In his "Requiem for Large-Scale Models" Lee (1973, p. 28) had been extremely critical about Forresters' *Urban Dynamics* and discredited it as being "unsuitable for policy analysis." Nevertheless, the political power of system dynamics for long-range planning, especially in the field of ecology, climate change, and urban planning, became widely known to policy makers and planners, through the work of Meadows, Meadows, and Randers (1972) for the Club of Rome. Their system-dynamics world models predicted an emerging ecological, energy, and demographic crisis. The models and outcomes were used for the alarming report "The Limits to Growth," published by the Club of Rome in 1973.[8] To better familiarize students, policy makers, and world leaders with the principles of system dynamics, as well as the complexity and urgency of ecological problems, Meadows developed a number of low-tech and widely-used simulation games, such as FISH BANKS and HARVEST (D. L. Meadows, 2000, 2001). They are still very powerful in their message, very engaging and easy to disseminate and facilitate. However, system dynamics inspired urban and policy gaming through another, unexpected route.

In the early 1980s, Jay Forrester's work and ideas on planning and urban dynamics inspired Will Wright, a computer game designer, to develop the best-selling *planning game* ever: SIMCITY.[9] As is commonly known, players of this computer game can build a city from the ground up and manage it. The game is therefore categorized as a God game, a simulation, or a strategy game. Over the years, there have been many new releases and versions, where players can, for instance, rebuild different cities after a man-made, natural or comic book catastrophe (war, flooding, or Godzilla) or focus on specific issues such as transportation or health (SIM HEALTH), planning scales (SIM EARTH), or communities (SIM SOCIETIES). SIMCITY is also unique in the fact that from its early releases, the computer game found its way to educational and research institutes, for lectures on city planning or complexity among other topics. The most recent versions of SIMCITY 4, with impressive graphical power, have been used for a national Swedish science program for schools, where teams of students developed ecological cities in SIMCITY 4 (Nilsson, 2008). The deeper meaning, uses, and possible impact of computer games in the strategy/simulation genre, such as CIVILIZATION, BALANCE OF POWER, or the highly original game concept of DEMOCRACY2 on public policy making is largely unexplored territory (Squire, 2004; Weir & Baranowski, in press).

Policy Exercises for Integrated Assessment

In the mid-1980s, global environmental change and its impact on things such as forests, river basins, desiccation, and floods became major issues of concern and debate in the science-policy interface and in the apparent hiatus between knowledge and action (e.g., Crookall & Thorngate, 2009). In comparison to other complex policy problems, environmental or climate change issues appeared to be a special case. They are usually global in scale and have long-term impacts. Data are generally inadequate and the phenomena are not well understood. Because of so-called deep uncertainties—the "unknown unknowns"—theories and data are often contested in scientific communities. Furthermore, the fundamental differences in values, worldviews, and even the interests of scientists, may interfere with their scientific assessments and judgments. This causes intractable controversies that cannot be solved by facts and knowledge alone. As a result, policies have to be made on the basis of uncertain, often contested input and under somewhat urgent conditions (Jäger, 1998, p. 143). What seemed to be required was a constructive negotiation and learning process among scientists and between scientists and policy stakeholders, albeit one that was evidence and science based.

In 1986, Garry Brewer, who as a RAND analyst had considerable experience with free-form gaming for policy analysis (see above), propagated the idea that long-term environmental problems required a new and innovative approach to scientific analysis for policy making. It was realized that more effective prospective methods were needed which could enhance interdisciplinary communication and learning among scientists and policy makers. He suggested that this new method, called policy exercise, would "find its procedural roots in scenario-based, free form games" (Brewer, 1986, p. 469; see also Brewer, 2007). Brewer's idea had some similarities with Lasswell's proposal of the decision-seminar (see above, Brewer, 1972; Mayer, 1997).[5] The policy exercise was defined by Brewer (1986) as

> A deliberate procedure in which goals and objectives are systematically clarified and strategic alternatives are invented and evaluated in terms of the values at stake. The exercise is a preparatory activity for effective participation in official decision processes; its outcomes are not official decisions. (p. 468)

The methodology of the policy exercise was initially not worked out at all. Still, several experiments, very similar to scenario-based free-form gaming, were conducted by the International Institute of Applied Systems Analysis (IIASA, Austria; Mermet, 1993), the Stockholm Environmental Institute (Jäger, Sonntag, Bernard, & Kurz, 1990), and other groups. One successful case was concerned with the impact of global climate change on the hydrology of the Po River in Italy and the policies that could best prevent such changes and impacts (Mayer, 1997, p. 98; Mermet, 1993). Other experiments were conducted, for instance, one by the Stockholm Environmental Institute (Jäger et al., 1990) on forest studies and climate change but also on energy, infrastructures and health care reform (Harvey, Lidell, & McMahon, 2007; Kuit, Mayer, & Jong, 2005; Mayer & Wenzler, 2005; Office for Public Management, 1990; Wenzler, 1993).

In the Netherlands, Jac Geurts propagated the idea of policy exercises in his inaugural academic address "Looking Back to the Future" in 1993 (Geurts, 1993). This inspired several policy exercises, gaming style, in the Netherlands. An interesting example is the gaming exercise that was part of the wider Metropolitan debate held in the Netherlands in 1997 (Frieling, 1998). It comprised a role-play game to simulate the participatory decision-making process for spatial planning in the Netherlands at a national scale. The participants played the role of private and public investors, governmental licensers, stakeholders, and citizens. As the game progressed, the future of the Netherlands crystallized in a GIS-based 3D world as a result of the decisions and influence of all the actors.

In two companion papers published in Simulation & Gaming, Toth (1988a, 1988b) attempted to formalize his IIASA experiences into formal policy exercise procedures.[10] The idea of policy exercises as a form of environmental war gaming caught on and was adopted by a community of scientists involved in (Participatory) (Environmental) Integrated Assessment (IA; Parson, 1996a, 1996b). IA was initially concerned with interdisciplinary computer modeling, such as system dynamics modeling of complex environmental problems. However, it became concerned with the process dimensions of decision making and the use of participatory methods, not only for large-scale environmental problems but also for other social-technological systems, such as cities (van Asselt & Rijkens-Klomp, 2002). It considered the weaknesses of two different types of scientific policy support: formal models (e.g., climate change computer models) and multidisciplinary expert panels, such as the International Panel on Climate Change (IPCC). Parson (1997) argued that

> These two conventional methods can usefully address some knowledge needs of global change issues, but are systematically ill-equipped to address others. To address the knowledge needs that are not well met by conventional methods, the paper argues for the use of a set of alternative methods, known by various names, including policy exercises, simulation gaming, and scenario exercises. (p. 267)

IA reflects on the methodological problems at the environmental science-policy interface. It tries to develop alternative methods, usually through an eclectic combination of computer intelligence with human and social intelligence. This makes them like a game:

> One important design variant is that such methods may have more or less of the character of a "game." While some authors argue that the hypothetical character of these methods make them all games, it is more common to define games as showing some combination of the conditions: structure and rules that guide participants' choices. (Parson, 1997, p. 274)

Serious (Computer) Games for Public Policy

Around the end of the 1990s and quite independent of each other, a large number of researchers operating at the science (MSG)-policy interface became fascinated by the staggering innovation and the potential of computer games. Some preliminary signs that computer games were about to change MSG for policy analysis were noticeable in the mid-1990s, for instance in the development of SIM HEALTH, a simulation of the U.S. health care system (Sawyer, 2002). Around 2000, a small group of researchers working on Environmental Systems Analysis at Wageningen University and the Energy Research Center in the Netherlands developed two SIMCITY-style computer games for policy analysis: SPLASH, on water resource management, and NITROGENIUS, a multiplayer, multistakeholder game about solving nitrogen problems (Play2Learn, 2009).[11] In his discussion of IA, Parson (1997) hinted that the distinction between simulation gaming and computer games might become blurred:

> The distinction between games for amusement may become increasingly blurred by advances in computer modeling power, however, which permit the development of simulations and games that are ambiguous in both their degree of representational fidelity and their intent. Such simulations, particularly when widely distributed, are liable to charges of perpetrating misunderstanding, analogous to the excessive confidence with which formal models have long been changed in regular policy processes. (p. 274)

Around 1970, Clark Abt (1970) had launched the notion of *serious games* and established how simulation games could be used for education, decision making, and the making of public policy. But the oxymoron *serious games* did not really take hold. Some 30 years later, around the turn of the millennium, the *serious games* notion was reintroduced for the use of technology and concepts derived from computer games developed for entertainment when they were used for nonentertainment purposes, like health care, policy making, education, and so forth (Crawford, 2002; Michael & Chen, 2006).

> Given the importance of models and simulations in public policy making, and the need to improve their effectiveness, the governmental and non-governmental model and simulation building communities should be striving to explore and build on other existing model-building practices. Some of the most interesting

work being done is within the interactive entertainment industry. (Ben Sawyer, 2002, p. 1)

The notion of serious games (also called social impact games, persuasive games, games with a purpose, etc.) literarily and figuratively brings together a large international community of computer scientists, game designers, think tank consultants, decision makers, and public policy makers. It is becoming a major global industry.

It is too early to say and there exists little empirical evidence for it, but computer game technology, computer game concepts, and the phenomena associated with them, such as game cultures, might be changing gaming for policy analysis. I shall mention several as-yet-to-be-fully developed lines of reasoning.

Culture. The first line of reasoning is cultural. The coming of age of the *net generation* or *digital natives* (Prensky, 2001, 2007). A significant proportion of students, including those in policy analysis or public administration, play online computer games on a daily basis. An increasing number of students are involved in the *modding* (modification) of commercial, off-the-shelf entertainment games, which allows them to develop their own new games, for entertainment or for serious purposes. The present and future generation of students of policy analysis, planning, and MSG will have grown up with computer games that are incredibly sophisticated in terms of user interaction. They will expect the same level of sophistication and interaction from the professional models, simulations, and serious games as their favorite entertainment games display at home.

Technology. The second line of reasoning is technological. The hardware and software in entertainment games—the game-platforms, the new user interfaces (the Wii game console, mobile devices) and game-engines (i.e., the core software that handles things like 3D graphics, physics, sound, and simulation)—are now not only extremely advanced and flexible but also cheap and readily available. So is Internet technology behind massively multiuser, online role-playing games (MMORPG) and virtual worlds (e.g., Second Life). New partnerships between game companies, research institutes, public and private organizations are constantly developing, especially to develop serious games for public policy purposes such as emergency management training of first responders or flood control. For recent reviews, see Morgan (in press), Moreno-Ger, Burgos, Torrente (in press), and Prakash et al. (in press).

Method. The third line of reasoning is epistemological and methodological. For some, computer games fundamentally challenge the traditional notions of fidelity and validity of simulations for policy making. According to Chris Crawford (2002), "simulation's greatest utility can be tapped only when we recognize it as a medium of expression rather than a form of calculation" (p. 2). And "by sharing the subjectivity with users, we invite them to internalize it and consider its significance, and ultimately to better understand the complexities of the problem" (p. 6).

Completely new attributes associated with entertainment computer games, such as engagement, persuasiveness, and subjectivity, are now being used and exploited for political and policy purposes. This is most clear in persuasive games: computer games, like SEPTEMBER 11 or AIRPORT (IN)SECURITY, or AMERICA'S ARMY, with a subjective political message designed to stimulate critical thinking and discussion (Bogost, 2007; Davis et al., 2003). They can not only be used for political propaganda but also to criticize authorities (Mayer, Harteveld, & Warmelink, 2009). Persuasive games therefore have potentially far-reaching consequences for activism as well as public participation. The relation between politics and policy making on the one hand and computer games, both serious and recreational, is unexplored territory and beyond the scope of this review article (Mayer, Harteveld, et al., 2009).

Intermezzo

In the previous sections, I have presented the intellectual and empirical evolution of gaming for policy analysis and planning. I have argued and demonstrated that gaming has been part of a wider institutional learning process in the decision sciences since World War II—from operations research to systems and policy analysis. It demonstrates that gaming is intricately connected to changing views on the complexity of public policy making and the evolving methods to frame and manage that complexity. The wonderful and remarkable characteristic of gaming is that it seems to coevolve within its ecological environment: the interface between politics and science. However, the institutional learning process behind gaming for policy analysis is not very well understood. It involves the following:

- **Cultural** changes, for example, about the role of science in politics, democracy, questions about the role of elites, activism and the call for participation, and most recently, factors such as the emergence of game cultures.
- Changes in the **perception** of public policy making, for example, from rational-comprehensive to political and incremental policy making, and so on.
- Manmade and natural **events** and how they influence the issue agenda, for example, the Cold War, climate change, depletion of natural resources, and so on.
- **Institutional** changes at the science-policy interface, the emergence of a think tank industry (e.g., RAND), and most recently, the rise of the media-entertainment industry.
- Technological **innovation**, for example, computer and simulation technology and new ways to represent complexity, like agent-based models, cellular automata, or virtual game worlds.

The Two Faces of Public Policy Making

So, we come back to the leading question of this article: Why use gaming for public policy making when we have so many sophisticated methods and techniques, from hard-core modeling and computer simulation to soft-core policy interventions, such as panels, workshops, and process management? My main conclusion is that the interpretation of what gaming is and how it should be used for policy analysis and planning very much depends on one's view toward public policy making in general: for example, whether it is *neat and rational* or *chaotic and messy* (see also Lindblom & Woodhouse, 1993; Mayer, Bekebrede, et al., 2009; Mayer, van Daalen, et al., 2004; Mayer, van Bueren, Bots, van der Voort, & Seidel, 2006).

Neat and Rational

If policy making is viewed as *neat and rational*—or at least, that it *should* be—we can very much rely on the methods and rational-analytic tools derived from science to support policy makers. As advisors to policy makers, we should use the best available knowledge and methods derived from the social, legal, technical, and economic sciences in order to provide answers to complex societal problems. At the same time, policy analysts should try to keep some distance from the political arena and remain as objective as they can.

As we have seen, the discipline of policy analysis has provided us with many rational-analytic tools—the policy analysis toolbox—by which we can reduce uncertainty or optimize solutions to policy problems. Typical examples are cost-benefit analysis, trend extrapolation, discrete event simulation, and agent-based or system dynamics modeling (Dunn, 1994). Operational gaming was conceived in this fashion.

Chaotic and Messy

The thing is that the messy perspective on governance and public policy making has found common ground. Its models and theories, such as bureaucratic politics (Allison, 1971), the garbage can model (Cohen et al., 1972), the policy stream model (Kingdon, 1995) and network theory (de Bruijn & ten Heuvelhof, 2000; de Bruijn, ten Heuvelhof, & In't Veld, 2002; Koppenjan & Klijn, 2004) are considered to be more in line with political reality. Policy scientists increasingly have come to realize that government is *not* a unitary body that seeks to optimize solutions to well-defined problems. Instead, government, similar to society, is fragmented into many loosely coupled agencies, departments, and individuals, who in many cases have their own interests in mind (e.g., departmental budgets or personal careers). This has contributed to theories that look at policy making through issue or policy networks with loosely connected and interdependent actors that interact in the policy process (Hanf & Scharpf, 1978; Heclo, 1978; Scharpf, 1997). The many stakeholders that operate in the policy arena often have different and conflicting views on the causes and consequences of societal problems. Facts are often disputed, knowledge is negotiated, and scientists are stakeholders—*hired guns*—in the policy arena (Jasanoff, 1990). Furthermore, there are many societal actors that are largely unresponsive toward deliberate government interventions, whether by regulations, subsidies, or taxes. And these stakeholders deliberately attempt to influence the outcome of the political process to their own advantage, for example, by lobbying, going to court, hiring consultants, presenting counter evidence, and most of all by making strategic use of their resources (money, authority, information) which government bodies depend on for the implementation of their policies. Thus, public policy making takes place in a dynamic interactive arena where policy issues come and go and where stakeholders enter and leave as they will. To some extent, real-world policy making resembles a strategic (messy) game, like a boxing contest lasting several rounds (albeit with changing players and ambiguous rules).

Multiactor Policy Making

Using the disciplinary terms of the policy sciences, we claim that policy making takes place in a *complex multiactor setting* where many interdependent public and private stakeholders have different and often conflicting values and interests. Deliberate government intervention in a multiactor setting therefore requires much more than a substantive, technical-rational analysis of the policy problem at hand, let alone optimal or near-best solutions (van de Riet, 2003). It requires the analysis of the policy problem within its strategic multiactor context.

The Two Faces of Complexity

Thus, complex policy problems, such as transportation, housing, climate change, health care, and so on have two faces of complexity and can therefore be labeled "complex sociotechnical systems." These two faces of complexity are

1. Technical-physical complexity: the emergent complexity as a result of the interactions among the physical-technical-economic entities within the system.
2. Social-political complexity: the emergent complexity as a result of the strategic interactions among the various stakeholders in the policy arena.

In the historic account above, we have found that gaming is intricately connected to theories about system complexity, such as cybernetics, system dynamics, and more recently, complex adaptive systems (Gell-Mann, 1994; Holland, 1995; Portugali, 2009). Each theory of complexity uses different types of simulations and models for the analysis of complex problems and provides strategies and tools for policy-support. Some examples are system dynamics, agent-based models, and cellular automata. However, despite the advancements in the understanding of system complexity as well as in the computer tools used to simulate, the full effects of policy decisions, especially in the long run, are difficult to assess (Druckman, 1971).

If we assume that policy making is inherently chaotic and messy, computer simulations of complex systems have a serious handicap: They are unable to cope with the unpredictable, strategic and frequently irrational behavior exhibited by real people and organizations. Or, when they do try to incorporate human behavior, human *actors* are reduced to *factors* such as variables or agents that can be put into a computer

Table 1. Technical/Physical and Social/Political Complexities

Technical/Physical Complexity	Social/Political Complexity
Quantifiable factors	Nonquantifiable factors
Many interdependent variables (system complexity)	Many interdependent, loosely coupled stakeholders (multiactor complexity; policy networks)
Cognitive uncertainty	Disputed or contested knowledge, values, and norms
Emergent behavior (e.g., counterintuitive)	Strategic behavior to optimize own interests, making use of loop holes in the policy
Design phases (linear or iterative steps of building and using model)	Dynamic rounds and arenas; volatile, erratic policy-making processes, stakeholders entering and leaving at will
Best solution, best available knowledge, optimization, validity, fidelity	Accepted solution, negotiated knowledge, political compromises
Hard computer tools: simulations, models, decision support systems	Soft tools: participation, process management

model. By themselves, simulation and modeling tools do not accommodate the political dimensions of multiactor decision-making processes.

As we have seen with IA, social-political complexity can be addressed, for example, through a participatory (or interactive) policy-making approach. However, without substantive input, evidence and analysis, participatory or interactive policy making and policy analysis runs the risk of being void. Participatory policy making, such as through panels and workshops, easily degenerates into a rather one-sided, superficial venting of desires and viewpoints at a time when plans have already reached an advanced stage (Mayer, 1997; see also Mayer et al., 2006). It can also lead to negotiated nonsense—a political compromise or consensus that is not supported by scientific evidence or can even be in conflict with physical-technical-economic reality (van de Riet, 2003). There is also the risk that innovative solutions will dissolve or be compromised in the participatory process and that experts will be disappointed by the quality and depth of discussion with policy makers and residents. Table 1 summarizes the two faces of complexity.

Two Sides of the Same Coin

In other words, complex multiactor policy making needs methodologies and tools that—apart from their evident suitability for addressing issues in a policy area, such as transportation or natural resources—are able to support both the technical-physical complexity and the social-political complexity of policy making. The trick is to bring the two forms of complexity together, not separately but integrated as two sides of the same coin. This of course, is easier said than done.[12]

Gaming is probably the only method in the policy analysis toolbox where real people—as actors or stakeholders—can be an intrinsic part of a computer model. Not as digital agents, but as real players with stakes, tacit knowledge, emotions, intuitions, and so on. Gaming makes it possible to address the technical-physical-economic complexity aspect—that is, the substantive complexity of the problem that can be modeled either through formal or more conceptual methods—as well as the multiactor aspect of policy problems. This unique capacity of gaming was realized early on, in the evolutionary development of simulation gaming. According to Duke (1980) and Taylor (1971), for instance, gaming is effective for policy analysis because

> Real world systems are based on *many variables* that interact with each other in *dynamic feedback* relations leading to *uncertainty* (. . .) many variables cannot be *quantified* and there exists no proven conceptual model or precedent to base decisions and actions upon (. . .) The social political context (. . .) shows *many actors* that may be *strategic* or a-rational and finally there is a *futures context* in the sense that the decision is irrevocable and the results will not be understood well into the future (summarized and adapted from Duke, 1980, pp. 364-365).

> First, on the nature of the phenomena handled by planners, it is increasingly recognized that the evolution of the urban development process is an extraordinarily complex and dynamic activity. In simple terms, it involves both physical and social systems; here lies the heart of the problem, namely the simultaneous handling of "both types" of system as they evolve and interact. On the one hand, the physical system is relatively simple to measure and represent as tangible elements are involved. The components of the social system, on the other hand, are not so convenient to handle, as volatile human behavior is very much involved (Taylor, 1971, p. 85).

In the next section, I will explore how this "linking of the two faces of complexity" works conceptually.

Gaming Complex Multi Actor Systems

Linear Thinking

Like most people, policy makers tend to think linearly, taking into account only a limited number of simple cause-effect and means-ends relations (Mayer, Bekebrede, et al., 2009). Many policy makers start their professional education by learning how to construct *cause-effect diagrams* and *means-end branching trees* (see Figure 1, see also Mayer, 2007, Mayer, Bekebrede, et al., 2009). Let us look at a simple example.

Energy Efficiency Labeling

The introduction of an energy efficiency labeling system for houses was legislated in the Netherlands some time ago. In short, this policy aims to lower energy consumption

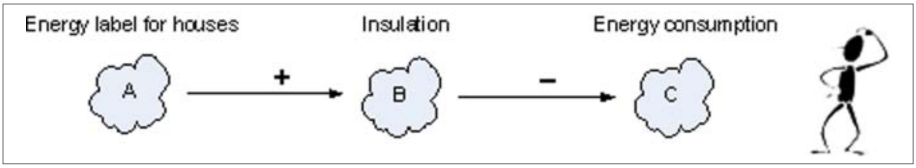

Figure 1. Linear causal thinking

by influencing the behavior of property owners (sellers) and property buyers. House sellers get incentives to take insulation measures, and buyers get incentives to consider the energy efficiency label of a property in their decision.

Unanticipated Effects

However, as we know from experience, reality is much more complex than the linear causal model suggests. The dynamic interaction among the economic, technological, and social factors can easily lead to unanticipated, unintended and/or undesirable effects. In a strained housing market with a distinct housing shortage, rapidly increasing housing prices, and significant social deprivation problems in urban areas, the energy efficiency label of houses in our example, is likely to be a minor point in the decision to buy or not to buy a house. Furthermore, policy sciences theories based on multiactor networks tell us that government is not a unitary body but is fragmented. Policy makers are dependent on many other public, private, and societal stakeholders, such as energy companies, real estate agents, and surveyors, for the proper framing of the problem and the solution. These stakeholders have a significant strategic influence on the implementation and execution of policy measures. During the implementation process, initial problem perceptions and policy objectives need to be interpreted, and in the process they get changed. In many situations, stakeholders are prone to stay closed or immune to the instruments of governance, such as taxation, regulations, or subsidies. It is also very difficult to make the incentive structure watertight. Stakeholders will try to find ways to optimize their own interests, to maximize their personal values, and to minimize their costs. It is not uncommon that policy measures have the opposite effect or negative side effects or cause problems in other policy areas. In our example, it might, for instance, hinder moving up the housing ladder, which in the Netherlands is an important policy objective of other governmental departments.

Gaming as Interaction With a Computer Model

In terms of cybernetics, the controller and the controlling mechanisms do not correspond with the complexity of the system they intend to control. The awareness that complex multi actor systems may behave differently than expected because of positive and negative feedback and time delays (as viewed by system dynamics), or because of

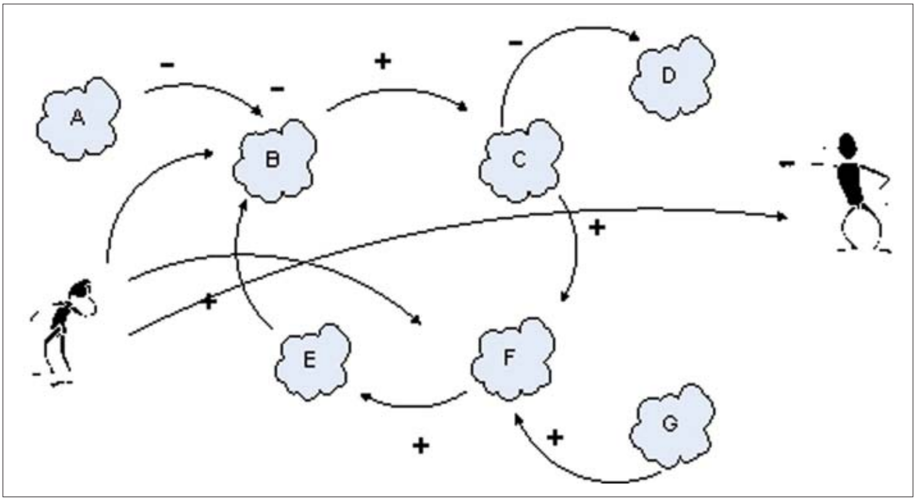

Figure 2. Playing with a complex computer model

the interaction between the various rules that guide the behavior of the agents (as viewed by agent-based models) and the strategic behavior of stakeholders (as viewed by multiactor policy-making theories) has significant consequences for the art and craft of policy analysis and planning.

Theories of complexity and dynamic modeling—through economic game theory, system dynamics, and agent-based models or otherwise[13]—can be used to understand and convey to policy makers the dynamic behavior of complex systems. In other words, we can try to anticipate through simulation. A major concern in MSG, however is the fact that the dynamic behavior of complex systems is not an easy message to communicate to policy makers and politicians. As we have seen, policy makers and modelers tend to live in different worlds. Gaming is therefore being used as an interactive interface built around rule-based simulation models: a hard core of modeling simulation in a soft shell of gaming. In this fashion, gaming facilitates policy makers' experimentation and learning about the behavior of complex systems before the plans, policies, or regulations have been implemented (see Figure 2; see also D. L. Meadows, 2000).

A typical example of such a game in the context of environmental change, urban planning, natural resources management, and so on, is a single-user computer game layered over a simulation model, whether simple or very extensive; let's say about the relation between different urban functions (like transportation, recreation, living, working, etc.) and factors such as sustainability or mobility in an urban area. Even when the validity and accuracy of the underlying model is fairly limited, the game is thought to convey important and useful complexity principles. Playing the game provides a satellite view of the problems. It may trigger new policy-relevant questions, which can be added to a research agenda for further investigation, and the identification of problem-solving strategies. As we have seen, significant parts of the literature on gaming for policy making focus on the enhancement of communication among simulation models, the experts that construct them and the policy maker or user. In fact, it is through this process that strategy games for entertainment, for example, SIMCITY and CIVILIZATION, can promote general learning about complex systems. It also explains why they have been taken as examples for the development of many serious games (Bekebrede & Mayer, 2006, see also above).

Understanding and Changing the Multiactor Game

However, the dynamic behavior of the system is not caused solely by the variables and rules represented in the computer simulation model. Nor does the *cognitive* understanding of a complex system necessarily have an impact on policy making. In order to make a difference in the intentional and strategic behavior, the actor-network itself has to be addressed and affected, taking considerations like political *wheeling and dealing* and the nonlinearity of the policy-making process into account. Cognitive understanding of policy problems also requires a strategic understanding of the actor-network configuration. Who are the stakeholders, what drives them, how much power do they have, what are their interdependencies, what coalitions are likely to be formed, etc? Role play or social simulations with stakeholders are frequently used to explore and change the behavior of policy networks (see Figure 3). The assumption is that the various actors will bring their own mental maps or belief systems to the game (Sabatier & Jenkins-Smith, 1993). These are based on core values, problem perceptions, and interests. The players will enrich their mental maps through interaction with the mental maps of others in the game. However, these mental maps cannot be isolated from the actor-network configurations in the policy network. Changing mental maps will also have a social and political dimension, involving factors such as building trust, forming coalitions, power plays, and so forth. Gaming is an intervention in a policy network situation that involves learning and changing the cognitive dimensions of a problem, while learning about and changing the social-political structure of the policy network at the same time.

Gaming Complex Multi Actor Systems

The main disadvantage of low-tech (or no-tech) policy games is that they can only handle a limited cognitive load. Analog game procedures are usually laborious: storing large quantities of information during and around the game for purposes of analysis is almost impossible; the options to replay or try it again are nonexistent; the possibility of fast-forwarding or slowing down is absent; the option to examine the really long-term consequences of actions and visualize them in real time is unavailable; and the possibility of having asynchronous and dispersed game-play or playing games with a large number of players (hundreds or more) is unthinkable. However, most importantly, social simulations fall short in a *reality check*. The

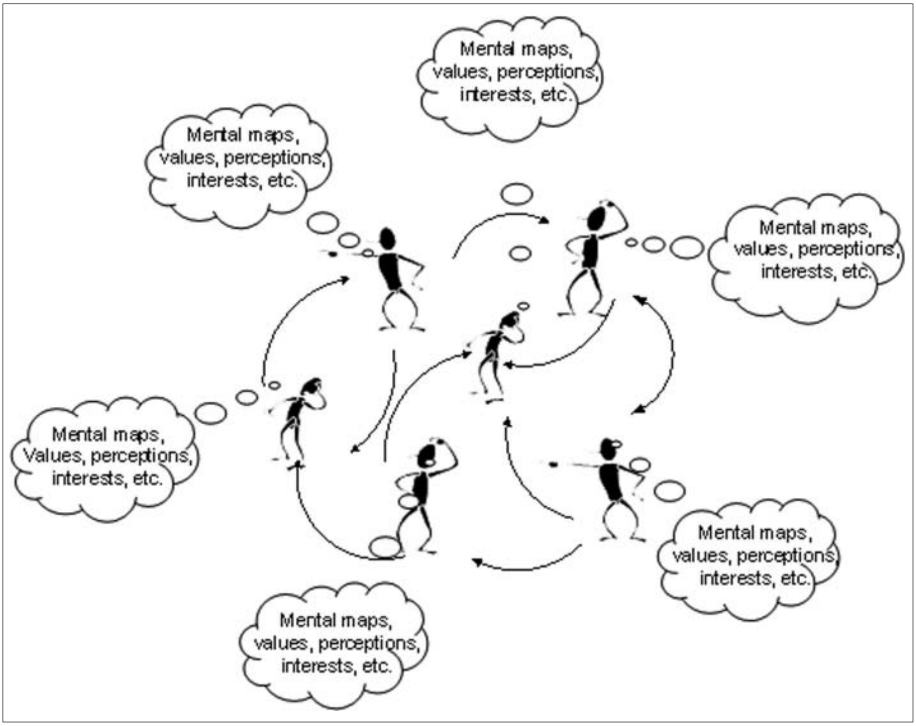

Figure 3. A multiactor game

players/participants can come up with much *negotiated nonsense*. Policy games can therefore also be multiplayer games with combined human-human and human-computer interaction (see Figure 4).

> The critical consideration (. . .) is how to link these types of computer simulations to free-form political gaming. That is, how does one mesh the computational rigidity and precision of the first with the human flexibilities and creativities of the second? (deLeon, 1981:224)

This is the picture portrayed for instance in the concept of the policy exercise and gaming for IA (see above). It portrays an emergent practice of multiactor, game-based interaction with simple or sophisticated computer models and simulations of reality. The image of entertainment and serious multiplayer computer games immediately comes to mind. A deeper analysis of cases unfortunately falls outside the scope of this article, but I have become particularly fascinated by the emerging applications in the field of multiplayer gaming for the military (VIRTUAL BATTLE SPACE), emergency training (LEVEE PATROLLER), urban planning (SIMPORT, CONSTRUCT.IT), and

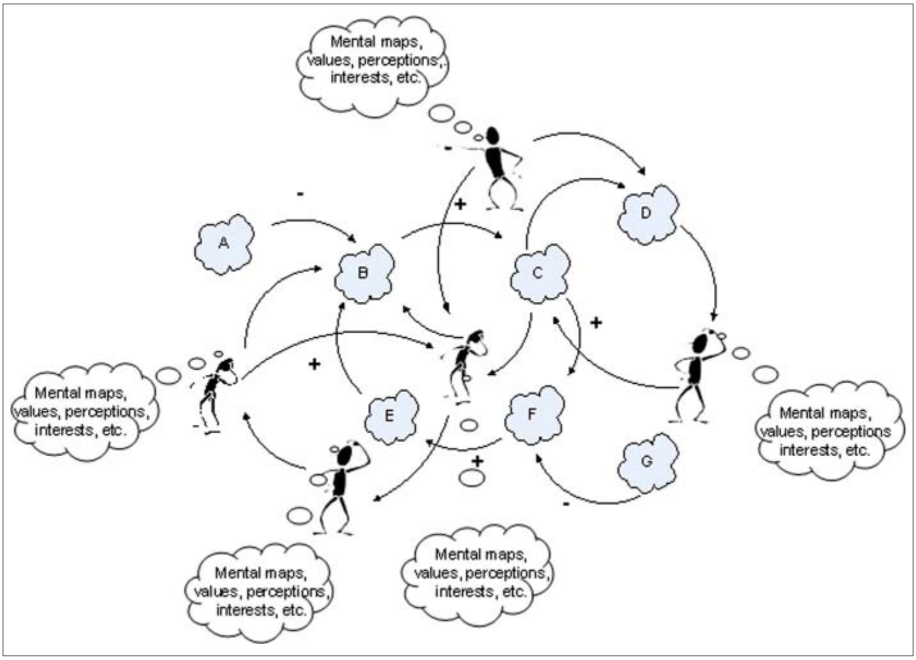

Figure 4. A complex multiactor game

natural resource management (Bots & van Daalen, 2007; Barreteau, Le Page, & Perez, 2007).

Conclusion and Discussion

In celebrating the 40th anniversary of the journal Simulation & Gaming and academic and professional associations like ISAGA, in this contribution we have looked back on the evolution of gaming for policy making. Games have great plasticity. They can be bent, molded, stretched, and shaped into many directions and forms. On the supply side, technology and designer creativity offer us new possibilities to develop new forms of game play, as the current popularity of online gaming (WORLD OF WARCRAFT, WoW) demonstrates. On the demand side, the practice of gaming for policy making has proved to be versatile. We have argued and illustrated that gaming evolved within a wider institutional learning process, as part of the interfaces between politics and science, and between policy making and modeling-simulation. To a certain extent, gaming is handicapped by the same weakness as modeling and simulation. It can be slow, irrelevant, and abused.

However, gaming also remedies some of the weaknesses felt in modeling and simulation—for instance, by opening up the black box and enhancing policy-oriented learning. In my view, policy gaming has unique characteristics not found to the same extent in any other policy analytic method. These are, essentially, the possibility of integrating technical-physical complexity with social-political complexity and letting policy makers and stakeholders play with that complexity. This is significant for complex multiactor policy making because it requires the integration of cognitive and social-political learning and change. The scientific foundations of gaming for policy making were found to be unstable. Is there any evidence that gaming is becoming accepted as a methodology for policy research and policy analysis? I would argue that it is. Over the last decade, an increasing number of PhD students in my own institutional environment have used or are using gaming as a serious research method in the policy sciences. It is up to this new generation of policy gamers, some of them fascinated by computer and serious games, to validate what we assume: that gaming really matters in the policy-making arena.

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Notes

1. In a recent contribution to the 40th anniversary symposium issue, Thorngate and Tavakoli (2009, p. 2) also observed that "we know of no recent and comprehensive review of how simulations are used for policy decision-making or evaluation of how much simulations improve the decisions made." Although they are not specific about the role of gaming, they argue that the influence of simulation operates through rhetoric, including by adapting our tools (simulations) to our audience (policy makers).

> We who indulge in policy relevant simulations are inclined to believe that they are powerful tools for improving policy choices. It is important to admit, however, that most

policy makers do not share our indulgence and remain indifferent to the beauty of our inclination. (Thorngate & Tavakoli, 2009, p. 13)

2. Although there are many parallels and similarities, I will leave out all discussions on gaming for business policy making, gaming for business strategy, business management, and organizational change (see also Geurts et al., 2007). I will focus solely on the use of gaming in a context of public policy making.
3. The early 1970s can definitely be labeled a heyday period; the eighties mainly one of consolidation. With the notion of *serious gaming* buzzing around at the time of writing, we seem to be going through another heyday period. I will come back to serious gaming, military and nonmilitary, further on.
4. Other names are Ed Paxson, Thomas Schelling, Carl Builder, Bob Levine, Peter Rydell, Bruce Goeller, Bill Schwabe, Milt Weiner, Amnon Rapoport, James Kahan, and Warren Walker.
5. Many of the reports, going back to 1959, can still be downloaded from the RAND Website (http://www.rand.org)
6. The alternative notion "seminar gaming" seems to refer to Lasswell's decision seminar; one of the first proposals to use a deliberate approach to use interaction and negotiation between a group of interdisciplinary scientists and policy makers for policy making, especially over a longer period of time (see also Brewer, 1972).
7. Since then, there have been numerous experiments worldwide showing a great variety of game-types and concepts: urban board games, role-playing games, computer-based simulation-games and, more recently, digital games (with SIMCITY as the most famous one), serious games and virtual (game) worlds for urban planning.
8. And even more critical about Jay Forrester's (recently introduced) urban dynamics for that matter. In general Forrester's approach of modeling and Meadows et al. Limits to Growth models received many critical reviews. See also the discussion on Forrester SD in deLeon (1975).
9. Maxis' SIMCITY was first released in 1989. For more information see the various Web sites and Wikis, for example, http://www.acmi.net.au/games_simcity.htm.
10. I have found no evidence that his six different types of scenario-based gaming have actually been used in the way Ferenc L. Toth presented them, or that his models have been validated.
11. The games were cofinanced by several Dutch ministries, described as Decision Support Systems and played and demonstrated at the 2nd World Water Forum and the 2nd International Nitrogen Conference, respectively.
12. In another publication I argued that the required methods and approaches should therefore have a number of characteristics (see Mayer et al., 2006)

    a. *Integrative:* They should consider different aspects and levels of policy making in a holistic and systemic way.
    b. *Dynamic:* They should be able to show the "performance" of various alternatives in relation to the preferences and "behavior" of stakeholders.

c. Interactive: They should be able to support the negotiation process between stakeholders.
d. *Transparent:* They should produce results that are clear and understandable to all stakeholders (they should not be a "black box").
e. *Flexible and reusable:* They should be usable for, or adaptable to, a range of (similar) situations.
f. *Fast and easy to use:* The required time to apply them should be relatively short, and non-experts, for example residents and politicians, should be able to use them.
g. *Communicative and educational:* They should be able to convey meaning and insight to stakeholders about problem structure, alternatives and different perspectives.
h. *Authoritative:* They should meet analytical standards of validity and political standards (e.g., they should safeguard core values and timeliness) in order to increase the likelihood that the outcomes are actually used.

13. The figures suggest a modeling of complexity through system dynamics. However, it can be done in many ways, for instance through agent-based modeling or cellular automata (see also Portugali, 2009).

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Bio

Igor S. Mayer is an associate professor in the faculty of Technology, Policy and Management at Delft University of Technology. He is also a director of CPS–TU-Delft/TPM Centre for Serious Gaming. He is a cofounder and board member of SAGANET—the Netherlands' Simulation and Gaming Association—and a member of the Netherlands Institute of Government (NIG). Contact: i.s.mayer@tudelft.nl.