# Is urban gaming simulation useful?

**Arnaldo Cecchini**
**Paola Rizzi**
*University of Architecture in Venice*

*The authors discuss epistemological, theoretical, and practical reasons for the crisis of gaming simulation in urban studies. The enormous successes obtained by hard sciences (particularly physics) in interpreting and changing the world have driven many scholars of the so-called soft sciences to believe that the methods and tools that had proved so successful at the so-called court of the queen of science might also be successful in the drawing rooms of the social and behavioral sciences. This belief has given birth to urban models. Its terminology revealed an inferiority complex toward so-called true science. It is with this set of issues that whoever deals with social sciences has to come to terms. This applies specially to urban sciences, which must take into account the social and the spatial (physical) dimensions.*

KEYWORDS: *artificial life; gaming simulation; participation; planning; urban models.*

Although it is true that Urban Gaming Simulation (UGS) had implicitly taken into account the social element of urban systems by removing part of the closed simulation model from its algorithmic description, it is undeniable that during the 1970s and 1980s the general crisis involving algorithmic models of social systems backfired on them as well. The origin of this crisis could be condensed to the question, Can UGS be useful not only for training but also for experimenting and predicting?

Claiming that gaming simulations are mainly training and predictive tools is sensible and useful, even if they map urban systems insufficiently. Obviously, it all depends on the questions, What are good UGS models? and What do we mean by prediction?

It is easy to see why and how UGS can be useful to experiment with and to use as tools for prediction. They offer us clues to identify sensitive conditions and outcomes, a sense of the right direction, short-term and long-term contradictions, and a few effective policy changes.

There is nowadays a renewed interest in regulative urban planning. The idea that it is necessary to guide the dynamics of urban development is now being accepted again. Gaming simulation has a future, as long as we connect it to new paradigms (such as that of artificial life), new models (such as those based on cellular automata), new tools (such as telecommunication networks), and new goals (such as forecasting based on scenarios), or to new forms of planning (such as those that see participation and interactive planning as essential elements). This article pays attention to all these aspects by means of theory and practice.

SIMULATION & GAMING, Vol. 32 No. 4, December 2001 507-521

## Origins

UGSs appeared at American universities in the early 1960s, following the successful applications of gaming simulations in military and business administration. American cities were at that time in a severe social crisis: racial riots, increase of crimes, birth of gangs of teenagers, and urban decay. This atmosphere of strong tensions was, however, counterbalanced by great trust in the future, as exemplified by President Kennedy's dream.

UGSs, in fact, are mainly urban training tools for planners and administrators, learning tools for students, and research tools for scientists. Like all gaming simulation techniques, UGSs are tools for simulating the effects of decisions made by people, assuming roles that are subjected to rules. Simulation refers to an urban model or, more in general, a land-use model. The general structure of UGS is depicted in Figure 1, which shows the three dimensions of role, simulation, and game that constitute the abstract space for UGSs.

In short, and essentially for educational reasons, part of the overall model is removed from the algorithmic description, which describes the mechanical or physical aspects of urban systems. This choice implies that the close model is becoming open to influences by the free game of social actors. Thus, the gaming part is linked with the mechanical side of the model. It defines the decision space for the actors. In this sense, UGSs are hybrid models that connect different epistemological traditions. It is important to underline that the techniques that find their basis in the definition of UGS are numerous. They depend on the positions taken in the three-dimensional space (see Figure 1).

As it invariably happens to gaming simulations, UGSs have proved to be excellent training tools. In addition, there was hope that in contexts of operational urban planning and design they could be useful as instruments of analysis, prediction, and policy making.

During the 1960s and 1970s we have witnessed a diffused flourishing of games for land use planning, even outside the North American and British breeding grounds. Then suddenly came the crisis that made UGS almost obsolete. In the first place it was a crisis that ended the reformist dream of social planning. In addition, it was a crisis of the paradigm on which UGSs were being built.

In the following sections we will point out that notions on urban planning coevolve with the epistemological and methodological considerations underlying the design of UGSs. We will start by paying attention to the crisis of urban models (especially large-scale models), such as in UGS.

## Crisis in model building

Lee (1973), in his article "Requiem for Large-Scale Models," describes what he considers the seven mortal sins of urban models. Harris (1994) has pointed out in his acute criticism of Lee that four of them have been overcome (at least partially) by

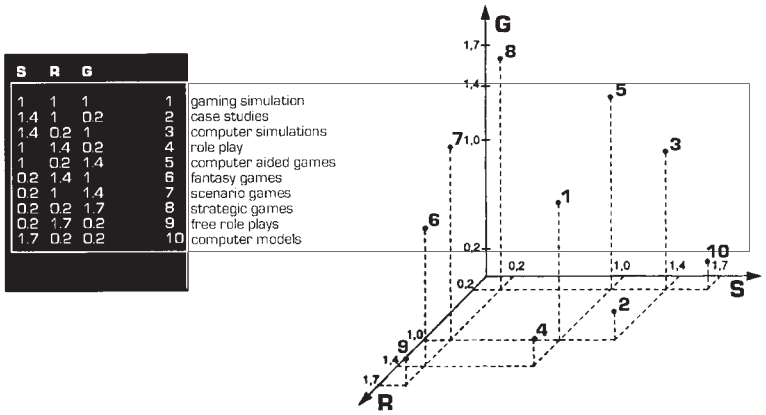


**FIGURE 1: Illustration of Three-Dimensional Space of Simulation, Gaming, and Role Play**
SOURCE: Cecchini and Frisenna (1987).

technological developments. These are hungriness for data, wrong-headedness of ideas, design complexity, and high costs. The remaining three sins (that large-scale models are hypercomprehensive, gross, and mechanical) are inherent to the logic of large-scale models. Later, Lee (1994) focused his criticism on three aspects. Large-scale models are fundamentally black box models, which claim to be general purpose and are inspired by the top-down approach steering in terms of command and control. However, the most acute critique of those types of models is probably the one described by Allen (1997). His statement has considerable consequences for anyone who deals with models. Allen pointed out:

> There is a critical difference between asking whether a systems obeys the laws of physics or whether its behaviour can be predicted from a knowledge of those laws. (p. 2)

Allen observes,

> We cannot really predict, but we can explore possible futures, and can help to imagine some of the properties of these. (p. 258)

Complex systems are very sensitive to initial conditions and—at some stages in their evolution—small changes in initial conditions can produce big, structural changes in the behavior of the overall system:

> History is made up of successive phases of relatively predictable development along a particular branch, separated by moments of instability and real change during which the future of the systems is laid down by some rather indeterminate chance events which push it onto one or another branch. (Lee, 1973, p. 18)

Urban systems add another element to the unpredictability of complex systems, namely the fact that people interact and their preferences are linked in a complex, coevolutionary way (Allen, 1997, p. 3). People often do not necessarily act on the basis of rational and sound reasoning, but follow sensations and opinions that depend on other people's choices and their changing sensations and opinions. This fact is important to those who build models for two different reasons: The first concerns the type of models that should be used, whereas the latter involves the purposes for which they could and should be used. Models are not for forecasting what will happen at one moment in time or designing the one best future:

> Just as central planning failed because of its rigidity in a changing world. The lessons seem to be that plans, which encourage variety and diversity tend to lead to creative and adaptive systems, capable of generating their own development and in responding to the challenges of the economic, natural and social environment. We should not conclude that the adoption of an unplanned free market system will necessarily produce success. As our models show, there are different possible structures that might emerge, and they can have qualitatively different attributes. It is important therefore to understand what kind of structures are possible, and to have some ideas of their relative merits, and what actions or policies might lead to which type of situation. (Allen, 1997, p. 252)

Models are tools for defining possible alternative strategies, for supporting decision making and understanding consequences of several simultaneous decisions, and for dealing with tensions between short-, medium-, and long-term effects. Furthermore, the computational and representational potentials available today enable us to build sophisticated yet user-friendly models whose structure and dynamics are easily understood. They enable the decision maker to effectively and straightforwardly simulate alternative choices:

> Through this process of exploration and testing, users will both improve the model, and improve their understanding of both the real system, and the model that is supposed to represent it. This learning process may perhaps be the most valuable part of the whole enterprise, since it can genuinely build mutual understanding and consensus between the actors. (Allen, 1997, p. 173)

## Crisis in social planning

The crisis in social planning coincides—but not at all accidentally—with the styles of rationalistic planning, as described by Peter Hall (1988) in his impressionistic history of planning and by Alexander (1992) in his functional classification. As Scandurra (1997) writes:

> Town planning came about with the Industrial Revolution, when for the first time in human history, society appeared to be organised definitively in the concrete form of the Nation State, a system which provided protection for its citizens in the form of the so-called Welfare State. It has since developed as an independent discipline (independent

> from architecture and economics) that deals with the structuring and usage of physical spaces for the safeguard of health, social assistance, education, and ever-widening social policies. A discipline, therefore, inherently reformist, and characterised by a utilitarian view (enlarging, edifying, measuring, rationalising, beautifying). . . . As a discipline in function of the social compromise between productive bourgeoisie, waged workers and the middle classes, town and regional planning has indeed played a decisive role in the organisation of physical space, but now perhaps that role has been exhausted in that modern society is increasingly less representable. Town and regional planning has designed cities on a Ford style model of productive and social organisation; a model that has since changed greatly: the organisation of labour has changed, as has the conception of nature, and finally, what else has changed is the model of scientific rationality elaborated by Galileo and Newton that led us to believe (and hope) that we might be able to predict and govern (control) the world; the secret certainty in the magnificent destinies and progress of humanity. (pp. 16-17)

## The crisis

We will discuss epistemological, methodological, and practical reasons for the crisis in UGS.

*Epistemological reasons*. As with all branches of knowledge, not strictly or genetically scientific, land use analysis has also passed (consciously or not) through a period of physicalism. It is well known that the positivist project, discarded almost at once in the 1970s, has been a paradigm dreamed of by all those disciplines that received less consideration and academic status than physics. The enormous successes of the so-called hard sciences (particularly physics) in interpreting and changing the material world have driven many scholars of adjacent disciplines to believe that the methods and tools that had proved so successful at the court of the queen of science might also be fruitful in the drawing rooms of the social sciences. That explains the birth of urban models. In their terminology they revealed a sort of inferiority complex toward true science (e.g., consider the application of the notion of entropy or the use of gravitational models). Whoever deals with social sciences has to come to terms with the approach of the hard sciences. This applies particularly to urban sciences, as they must take into account the spatial dimension of human settlements.

There is another crucial aspect to add: The aim of urban planning is not only to describe, analyze, and interpret urban development, but its aim is above all to predict and devise strategies to reach feasible futures. By removing parts of the overall model from the algorithmic description of formal models, UGSs had somehow implicitly taken these goals into account. Yet it is undeniable that the crisis involving large-scale, algorithmic models, on which they were based, has been transplanted to UGS.

*Methodological reasons*. The origin of this crisis involves the use of gaming simulation techniques. It could be condensed in a question: *Sic stantibus rebus*, can UGS be useful not only for training and analysis, but also for prediction?

It is fairly obvious that what serves as a means to learn about a complex system has an inherent heuristic function. In addition, when it explains how a system works, it also enables us to make predictions. Understanding even partially how complex systems work helps to formulate correct questions and consequently to increase and enlarge our ability to analyze. The claim that UGSs (or gaming simulation in general), in addition to being training tools, are also sensible and useful for predictions depends on what one considers a good model. Are purely algorithmic urban models better than hybrid models that are based on a mechanical submodel connected to a system of actors? An answer to this question also depends on what we mean by prediction and what criteria are being used. In this regard, the following question needs to be addressed: How to cope with a fundamental conflict between the short- and long-term consequences of a policy change? If skepticism is a realistic attitude in this context, it is easy to see under what conditions UGS can be useful to make predictions. It all depends on the clues they offer to identify sensitive issues, to identify right and just directions, to explore short- and long-term contradictions, and to enhance a few effective policy changes. Here comes the crux of the problem. Urban gaming designers confined themselves to use UGS mainly for training purposes. Moreover, when they enlarged them for analytical and forecasting purposes, they had to come to terms with the epistemological crisis of the paradigm underlying large-scale modeling.

*Practical reasons*. Finally, during the 1980s doubts emerged about a question that urban planners had taken for granted. To what extent is it possible to drive urban development processes through a rational and enlightened planning? Previously, a plan devised by competent scientists was viewed as a valid governing tool. It was assumed that it could improve the ability to manage social processes, to take economic interests into account and bridle them, and to predict social dynamics.

Before the 1980s we witnessed a rapid development of society as a whole. Both social control and use of the market were considered possible and necessary. Reformism in its various versions was able to reaffirm itself from the American Roosevelt model to the North European social democratic one. Moreover, since 1945 the world (with the exception of few prophets of woe) had regained its sense of rationality and direction. UGSs were considered effective planning tools, and as such they profited of this favorable atmosphere that made us believe that conflicts could be rationalized and once understood they could be settled.

The bitter awakening during the 1980s caused a crisis in these strong convictions. During the 1980s, what Leopardi (1836) called "the extraordinary and progressive destinies of history" were rediscovered. The heritage of a past made of racial conflicts, poverty, casting out of groups of citizens, the loose appetites of speculation, economic stagnation, and regional disequilibria had to be overcome. All the techniques and methods of UGS, which were associated with such a naive perception of progress and reformation, had been swept along with the crisis. That is why public management has stopped using UGS. It is not easy to offer exact figures. Very few games have been designed since the mid-1980s, and fewer and fewer have been the articles on UGS and even fewer the sessions of games played.

The crisis of classical urban planning has emphasized the epistemological and methodological crisis in gaming simulation mentioned above. It hit even those UGSs that were more innovative and less connected to the reductionist and positivist statute of physics. However, history is shrewd. UGS, hardly surviving in the academic world, has flourished in the great world, in the market of video games. SIMCITY is the most evident example. Nowadays, there is also a renewed interest in regulative urban planning, although deprived of its rationalist aspects. After the ideological excesses of deregulation, the idea that it is worthwhile to guide the dynamics of urban development is now being accepted again.

## A new perspective

UGSs will have a great future, but only if we will be able to rethink and revise the epistemological and political frameworks that enclose UGSs and address the requirements they have to satisfy to be embedded in them.

*The frame*. Today, the epistemological framework is enriched by the birth of the paradigm of complexity. It is gradually claiming a vital part in the scientific world and establishing its methodological coordinates. The science of complexity addresses exactly those aforementioned epistemological questions. Therefore, urban modelers, if they redefine their role and know-how and reelaborate their reference models, could become principle agents of this methodology. The new technology could provide a major contribution to the construction of new models. Additional to the difficulties that relate to building urban models is the notion that many models of evolution of cities are used as metaphors rather than analytic models.

In the analysis of urban dynamics, two perspectives can be taken into consideration:

- observe the city from the top of a hill and see it in its entirety and in its physical context, and
- walk in the streets and interact with the inhabitants, and discover that those who move across the city do so for different reasons, each person for more than one reason.

In addition, from a scientific point of view, qualitative, quantitative, and mixed models are taken into account. In principle, the various perspectives and types of models help us to see things differently. In this sense they complement one another and improve our understanding. Therefore, they should not be integrated into one internally consistent whole. That would reduce variety of perspectives.

All town and regional planners have used models in the various phases of their profession. They did it in different ways. Like Monsieur Jourdain, the bourgeois gentleman depicted by Molière, planners spoke in prose without even realizing it. Nowadays, there is a return of interest in regulative town and regional planning. After the ideological infatuation with deregulation, the idea that town and regional development dynamics should be guided (perhaps through new instruments) is once again

acceptable. Under stringent conditions, provided by the science of complexity, we might expect urban models to have a great future. The reasons are as follows:

- The role of the town and regional planner can no longer be considered a linear series of disjointed sectorial tasks. It requires a general skill, a savoir faire, and an ability to adapt to evolving circumstances and to deal with the unexpected. This understanding will have significant effects on their training and consequently on the organization of the educational system.
- A plan is necessary to support sustainable urban and regional development. It is no longer an enlightened plan based on a reductionist epistemology and a centralized hierarchical management system. It is developed via participating individual citizens and groups. This approach makes them coresponsible for the planning process. Such a plan is a social construct, shaped and reproduced via interactive government.

*Conditions*. The reference models must be reviewed, and it is therefore essential that urban models result from a long period of cross-fertilization with other disciplines and with new analytical techniques. In this area there is still much work to do. (Reference models denote those urban models that map particular aspects of cities or regions, especially the physical aspects of land use.)

Describing the behavior of urban systems on the basis of a partially closed model and linking part of the algorithm with the bounded action of the agents involves the risk of making the model unstable. Identifying criteria and conditions by which models are sufficiently robust will become vital. It is necessary to choose the most suitable technique in relation to an adequate classification of urban models. Such a classification should not only display the visible characteristics but also the underlying features. Among others, the following questions need to be addressed:

- Which theory is being addressed?
- What conception of the conflict between parties is being implied?
- Does the model have areas where it is in equilibrium?

> I personally hold that formalisation and modelling are necessary to scientific research and I greatly appreciate the efforts of those who work in this field. However, in my opinion, the "partial models" seem to be more useful than the "general" ones, also because it is very seldom that a researcher has at his disposal the appropriate amount and quality of means to be able to elaborate a "rich general model" that is up to the situation. . . . I am not a great expert on models, but I appreciate their importance and usefulness on the one condition that they add to knowledge and enrich interpretations, and do not only translate into more or less rich formulations what one already knew. The phenomenon, which is the object of our study is in a state of constant transformation, and no special attention is needed to be able to notice the signs of this transformation, in that they are so often very apparent, but the interpretation of the movements at times seems to be more complex. No instrument should be shunned, and no amount of effort should be derided; this, however, without denying that very often the "glasses" through which we observe the urban phenomenon are very diverse (but this is a matter of discussion amongst researchers). It is these glasses, then, rather than the models themselves that allow us to look beyond, to delve into reality, and grasp its profound movements. (Indovina, 1995, p. 11)

In general terms, strategic problems are not resolved by refining the tactics! The lesson to be learned is that for every discipline that has a weak epistemological basis, there should be a healthy coexistence of different competitive techniques.

How much computation is needed? Computation is understood not in the sense of brute force of modern day computers. A plumber is not a scientist per se, although practicing a scientific method. A plumber knows which tools to carry without overloading the bag, knows how to arrive at a temporary solution without losing sight of the objective, and is satisfied with solutions that are less than optimum. As we will restrict ourselves to plumbers, we are speaking of great artisans of practical reasoning. To sum up the science and art of model building: It is better to do less, but to do it better. Although the power of calculation is important in managing databases, brute force is not called for. Sophistication and flexibility are required.

The real paradigm shift in UGS lies in substituting the earlier objective of bureaucratic control with participatory impact assessment; in balancing strong and weak ideas; and in envisioning change, guidance, and direction.

## Urban gaming simulation and urban models

We have indicated key elements that are necessary to regain space and perspective to that particular category of urban models represented by UGSs. The ideas presented above are forcing us to reflect more thoroughly on the reasons why description, interpretation, explanation, analysis, and prediction of urban dynamics require a real and pervasive philosophy modification. Essentially they ask for a new metabasis.

Governing cities means above all understanding the (current) limits to their development. In essence, the matter at hand is to understand the nature and dimension of the constraints, which manifest themselves in the social and economic reality of today, and in our immediate future. This can be achieved by coupling short- with long-time perspectives, by linking smart tactics with good strategy, and by generating instant satisfaction with lasting gratification, taking into account that any governor's notion of time usually does not exceed the generation of the grandchildren or term in office.

It is difficult to think about any policy whose time span is longer than half a century, considering moreover that the validity of a forecast for such a long period of time is close to zero. Perception of time in human history is completely different from the time dimension in nature. In that respect, politicians should be aware of the increasing global effects of local political decisions. Today's major risk is no longer the extinction of one specific city, but the loss of a civilization that is represented in urban culture.

In the meanwhile, we should be careful not to reiterate the prisoner's dilemma or the tragedy of the commons in the competition between cities. Governing a city means knowing how to use effective public policies while considering all viable options. First-order or classical cybernetics focuses on steering and control. Applied to cities, it represents a top-down form of government. It should be made clear, however, that whoever governs does not necessarily have to directly administer the mechanistic instruments of his or her cybernetic policies. Considering the nature of direct and

indirect policies, both can be dissuasive or persuasive. Moreover, they can be regulatory, monetary, psychological, and cultural. In the case of cities, policies should be open to public debate. The role of models in the government of cities is fundamental and they should receive proper attention, especially in relation to planning. One should not forget that grand objectives are not achieved with grand policies, such as in the era of the planned economy. They should be addressed by great policies that are flexible, show the ability to maintain a sense of balance between perceptions and positions of multiple actors, and accept the possibility that many social subsystems have the capacity to recreate themselves.

A good politician will intervene effectively when and where it is needed. Decisions need to be made that are open and reversible as long as suitable on the basis of understanding the territory and emerging tendencies. Within such a political context, UGS and other urban models can simulate alternative scenarios for a defined time span. They should indicate their costs and how they can be covered.

It should be pointed out that the city is an extraordinary but costly institution, characterized by integration and exclusion. It is the habitat of many human beings, their true ecological niche. Our species is unique in the sense that its adaptability is expressed through the evolution of its memes[1] (Dawkins, 1976), which is a process that is quick, direct, and inconclusive, rather than the evolution of genes, which is a process that is slow, indirect, and finalized. The missing alignment between these two evolutionary processes can bring about disastrous consequences.

The historic centers of cities and their cultural inheritance are the storehouses of the mimetic pool, the place where the entirety of information and codes is gathered, conserved, adapted, and transformed. A sustainable city is mainly a city that preserves its past to produce and constantly reproduce its future. The city of Venice has demonstrated this capability for centuries, but its possible disappearance as a city—already quite probable and close—is due to two opposite forms of pressure: on one side, the inability to control and limit the pressure of the city on its environment, and on the other side, the loss of social functions and diversity and the full and uncontrolled domination of tourism as a type of monoculture that (like all monocultures) is unsustainable.

To model such a city adequately requires taking on board the epistemological, methodological, and practical considerations discussed above. Modeling urban systems requires the linking of many approaches and even many scientific languages. They should enhance an ongoing dialogue, an easy exchange of data and information, to achieve coherence among all parties.

This is what we expect from a good model.

A model should:

- not be a black box (it is essential that all who use it for planning purposes understand how it works and why it works that way—therefore, it should be a white box);
- enable the assessment of many alternatives;
- enhance participatory impact assessment of policies;
- be compatible with other models, even when these are different in their formulation and techniques;

- be parsimonious (it should not require an excessive number of variables, an excessive amount of data, and an excessive computational power);
- be flexible to different situations and contexts of use and be fed, processed, and handled with the available types of information and knowledge;
- be fast to build, at least compared to the time required to realize the project for which the model is built, and it should fit into the evolving planning cycle; and
- be reusable and never be something that can happen only once in time and space.

Looking carefully at all these preconditions, we can see that models are needed to design the new generation of UGSs that meet the following requirements.

We want them to:

- be useful for the end-users and designed in cooperation with them;
- be capable to linking them with other models;
- be easily reusable and adaptable (true frame-games);
- provide a diffused awareness of problems, hints on how to define and evaluate alternative scenarios, instruments of collective discussion and negotiation, and consistent pieces of communicative strategies;
- be built with the best available methods and techniques (which does not necessarily mean the most modern ones)—sometimes pure and simple role-plays made with paper and pencil can be useful and sufficient; and
- be inexpensive and accessible.

It is an obligatory path, but for that reason no less creative and fascinating.

## Examples of newly developed games

In line with the conditions for models and UGSs depicted above, we will present some newly developed games. With respect to their typology, we refer to Feldt's proposal of classification that subdivides UGSs in four categories: frame games, empathy games, resource allocation games, and process games (Feldt & Rycus, 1988).

### Frame games

FUTURE-X is a software version of the original game of FUTURE. Substantial innovations to the original game have been introduced. It contains a more statistically robust algorithm of execution. As a logical consequence of all the innovations introduced in the FUTURE-X game, the software THE TIME MACHINE was developed that eliminates the gaming part and puts all the accent on the extensive analysis and scenario construction.

FUTURE-GORIZIA (Rizzi & Zago, 1995) is an implementation of FUTURE-X and THE TIME MACHINE model on the relationships between two bordering cities Gorizia (Italy) and Nova Gorica (Slovenia).

MIMESI is the final product of a research program on the design of a frame-game started in the 1980s with the realization of the VAGUE game, with its successors NOUVELLE VAGUE and NEW WAVE. It is a territorial gaming simulation that

allows one to experience different governance possibilities for the future of a city or a portion of territory through consensus building and negotiation.

### Empathy games

SIMSCI is an adaptation of SIMSOC (Gamson, 1969, 1972, 1994). The industries are substituted by scientific laboratories, different theoretical perspectives by political ones, media by publication outlets, and judicial by granting agencies.

THE WORLDS OF NEW MILLENIUM (Cecchini & Montanari, 1993) is a role-play game: Players simulate a global conference where the destiny of the planet in its environmental, economic, and political aspects has to be decided.

### Resource allocation games

CAT (Cellular Automata Tool) is based on the use of cellular automata in the territorial analysis (Batty & Xie, 1994; Cecchini, 1999a; Couclelis, 1985; Tobler, 1979; White, 1996). The software CAT allows the easy definition of entities (states of the cells) surrounded by the spatial preconditions and transition rules. Having resolved the problem of the simulation in this manner, the definition of roles and the modalities of decision making is open and can be freely defined.

AUGH! (Rizzi, 1999) represents a family of UGSs. It has taken us to the realization of specialized automata and to the idea of the multiautomata. From these experiences was born the idea of realizing scenarios based on Cellular Automata, to be used in environmental education. The software has been applied successfully in the study of the real-estate market trends in a Spanish city.

### Process games

The first gaming simulation exercise that UNCRD developed in 1984 was called REPLEX, signifying "REgional Planning Exercise." In 1995, UNCRD developed a new gaming and simulation exercise for regional planning focusing on sustainable regional development, PANGAEA (Kanegae & Kaneda, 1996). The new game is based on the building of a nation in a young virtual island-country, presumably located somewhere in Asia and the Pacific Region. PANGAEA enables participants to improve their behavioral skills such as negotiation and coordination to understand the complexity of the planning process and to formulate plans in rational manners supported by microcomputers.

## Summary

Urban systems are social systems. Their physical parts, that is, their land use, can adequately be modeled in terms of formal, mathematical models. Here we do not refer to the traditional approach. For reasons expressed above, we favor so-called

self-organizing models, inspired by the artificial life paradigm of cellular automata, neural networks, and multiagents models (Cecchini, 1999b). It is not necessary that these models be omnicomprehensive and completely coherent. They can be of different types, each of them adequate in describing different aspects of the physical part, but they must enable intercommunication and represent modules of a generic description. These models are open to the interventions of social actors. That social part is constituted by roles and rules. The formal model simulates physical processes and evolves partially via the roles and rules that represent the gaming component of the metamodel. As a consequence UGSs are open, hybrid models.

These models serve a new conception of planning that fits into the tradition of regulative and rational planning. They do not pursue a reductionist optimal solution based on a narrow technical rationality. They explore different possible paths and allow an understanding of the realm of complexity, the interconnections between the different parts, and the characteristics of the emerging social system. They aim at enhancing governance based on utilizing interactive learning environments for policy makers. Due to the very nature of gaming simulation, UGS models encapsulate the capacity to develop the apprehension and learning skills of decision makers on all scales by provoking the opening of the mind in a continuous search for improvement.

## Note

1. Dawkins (1976, 1986) defines this unit of information as the particular patrimony of the species, that is, culture—the transmission of capabilities, knowledge, and abilities through the memes, which allows the human species a sort of inheritance of acquired attributes that accelerates and diversifies its evolutionary process.

## References

Alexander, E. R. (1992). *Approaches to planning: Introducing current planning theories, concepts and issues*. Yverdon, Switzerland: Gordon and Breach.

Allen, P. M. (1997). *Cities and regions as self-organizing systems: Models of complexity.* Amsterdam, the Netherlands: Gordon and Breach.

Batty, M., & Xie, Y. (1994). Modelling inside GIS. Part 1: Model structures, exploratory spatial data analysis and aggregation. *International Journal of Geographical Information Systems*, *8*(3), 291-307.

Blecic, I., Cecchini, A., & Rizzi, P. (1998). The time machine: Gaming and forecasting. In J. Geurts, C. Joldersma, & E. Roelofs (Eds.), *Gaming/simulation for policy development and organizational change*. Tilburg, the Netherlands: Tilburg University Press.

CAT (Cellular Automata Tool). Buso, M., & Rizzi P. (1999). Venice, Italy: Stratema Laboratory, DAEST-IUAV.

Cecchini, A. (Ed.). (1999a). *Meglio meno ma meglio: Automi cellulari e analisi territoriale*. Milano, Italy: Angeli.

Cecchini, A. (1999b). New information and communication technologies and the professions of town and regional planners. *Computers, Environment and Urban Systems*, *23*(3), 151-172.

Cecchini, A., & Frisenna, A. (1987). Gaming simulation: A general classification. *Simulation/Games for Learning*, *17*(2), 60-73.

Cecchini, A., & Montanari, P. (1993). *I mondi del nuovo millennio*. Molfetta, Italy: La Meridiana.

COMMUNITY LAND USE GAME, The. Feldt, A. G. (1966). Ithaca, NY: Center for Housing and Environmental Studies, Division of Urban Studies, Cornell University.

Couclelis, H. (1985). Cellular worlds: A framework for modelling micro-macro dynamics. *Environmental and Planning*, *17*, 585-596.

Dawkins, R. (1976). *The selfish gene*. New York: Oxford University Press.

Dawkins, R. (1986). *The blind watchmaker.* New York: Norton.

Feldt, A., & Rycus, M. (1988). Analytical methods. In H. C. Dandekar (Ed.), *The planner's use of information*. Chicago: Planners.

FUTURE. Helmer, O., Gordon, T. J., & Goldschmidt, H. (1966). Middleton, CT: The Institute for the Future.

FUTURE-GORIZIA. Blecic, I., Rizzi, P., & Zago, M. (1997). Venice, Italy: Stratema Laboratory, DAEST-IUAV.

FUTURE-X. Blecic, I., & Rizzi, P. (1996). Venice, Italy: Stratema Laboratory, DAEST-IUAV.

Gamson, W. A. (1969). *SIMSOC: An instructor's manual*. New York: Free Press.

Gamson, W. A. (1972). *SIMSOC: Simulated society: A participant's manual and related readings*. New York: Free Press.

Gamson, W. A. (1994, June). SIMSOC at 30. *Simulation & Gaming*, 208-212.

Gorman, M. E. (1998). *Transforming nature: Ethics, invention and discovery.* Boston: Kluwer Academic.

Hall, P. G. (1988). *Cities of tomorrow: An intellectual history of urban planning and design in the twentieth century.* Cambridge, MA: Basil Blackwell.

Harris, B. (1994). The real issues concerning Lee's "Requiem." *Journal of the American Planning Association*, *60*(1), 31-34.

Indovina, I. (1995). Nuove condizioni ed esigenze per il governo urbano. In C. S. Betuglia & F. Vaio (Eds.), *La città e le sue scienze: Vol. III. La programmazione della città* (pp. 95-115). Milano, Italy: Angeli.

Kanegae, H., & Kaneda, T. (1996). *A gaming simulation model for training in sustainable development planning: The basic concept of PANGAEA, vol. 2: Regional development studies*. Nagoya, Japan: UNCRD.

Lee, D. B., Jr. (1973). Requiem for large-scale models. *Journal of American Planning Association*, *39*, 173-178.

Lee, D. B., Jr. (1994). Retrospective on large-scale urban models. *Journal of American Planning Association*, *60*, 35-40.

Leopardi, G. (1836). La ginestra o il fiore del deserto. *Canti*, *XXXIV*.

METRO-APEX. Comex Research Project. (1974). Los Angeles: The University of Southern California, Eric Document Reproduction Service (ED 104 697-717).

MIMESI. Stratema Laboratory, Forum Cooperazione Tecnologia, Metid-Politecnico di Milano. (1999). Venice, Italy: Author.

NEW WAVE. Blecic, I., Cecchini, A., Indovina, F., & Rizzi, P. (1995). Venice, Italy: Stratema Laboratory, DAEST-IUAV.

NOUVELLE VAGUE. Cecchini, A., Indovina, F., Pezzato, G., Rizzi, P., & Viola, F. (1993). Venice, Italy: Stratema Laboratory, DAEST-IUAV.

PANGAEA. UNCRD. (1996). Nagoya, Japan: Author.

Rizzi, P. (1998). Co-evolutive games. In J. Geurts, C. Joldersma, & E. Roelofs (Eds.), *Gaming/simulation for policy development and organizational change*. Tilburg, the Netherlands: Tilburg University Press.

Rizzi, P., & Buso, M. (1999, September). *Cellular automata applications: From environmental education to urban and regional analysis*. Paper presented at CUPUM'99 (Computer in Urban Planning and Urban Management) 6th international conference, Venice, Italy.

Rizzi, P., & Zago, M. (1995). "Il futuro delle città gemelle di Gorizia-Nova Gorica: Un esempio di simulazione giocata. *Futuribili*, p. 3.

SIMCITY. Wright, W. (1989). Walnut Creek, CA: Maxis Software Co.

SIMSCI. Gorman, M. E. (1998). Boston: Kluwer Academic Press.

SIMSOC. Gamson, W. A. (1969). New York: Free Press.

Scandurra, E. (1997). *Città del terzo millennio*. Molfetta, Italy: La Meridiana.

TIME MACHINE, The. Blecic, I., Cecchini, A., & Rizzi, P. (1995). Venice, Italy: Stratema Laboratory, DAEST-IUAV.

Tobler, W. (1979). Cellular geography. In S. Gale & G. Olsson (Eds.), *Philosophy in geography*. Dordecht, the Netherlands: D. Reidel.

VAGUE. Cecchini, A., Indovina, F., Pezzato, G., & Viola, F. (1985). Venice, Italy: Stratema Laboratory, DAEST-IUAV.

White, R. (1996). Artificial worlds: Are they real? The view from cellular dynamics. In E. Besussi & A. Cecchini (Eds.), *Artificial worlds and urban studies*. Venice, Italy: DAEST-IUAV.

WORLDS OF NEW MILLENIUM, The. Castagna, A., Cecchini, A., Montanari, P., Musci, E., & Pentasuglia, M. (1997). Unpublished game.

*Arnaldo Cecchini works on theoretical and operative research in the fields of new techniques for urban and regional analysis (particularly simulation, gaming simulation, and cellular automata) and of new technologies and information systems for participatory planning and forecasting. He is a professor of urban systems analysis at the School of Urban, Regional and Environmental Planning of the University of Architecture in Venice. From 1987 to 1989 he was president of the International Simulation and Gaming Association (ISAGA). Since its founding in 1986, he has been director of the Italian Society of Gaming Simulation (SIGIS).*

*Paola Rizzi is a town planner with a master's degree in business management and works on urban planning in simulation and territorial analysis techniques. She is an expert in gaming simulation. She designed and planned many simulation urban games and other ones for company training, as well as different games for participation, even into the Internet. In the research field she has undertaken some studies and planning of new tools for urban analysis and participation to decision and planning processes on tele-working, new technologies, and communication on cellular automata applications.*

*ADDRESSES: AC: DAEST, Dept. of Urban and Regional Social-Economic Analysis, University Institute of Architecture of Venice, Santa Croce 1957, Venice, 30135, Italy; telephone: +39 041 2572156 (work), +30 041 720264 (home); fax: +39 041 5240403; e-mail: bibo@iuav.it.*
*PR: DAEST, Dept. of Urban and Regional Social-Economic Analysis, University Institute of Architecture of Venice, Santa Croce 1957, Venice, 30135, Italy; telephone: +39 041 2572156 (work), +30 041 5210794 (home); fax: +39 041 5240403; e-mail: rizzi@iuav.it.*